The Evolution Of Program Design

COMPUTE!'s GAZETTE

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November 1986
Issue 41, Vol. 4, No. 11
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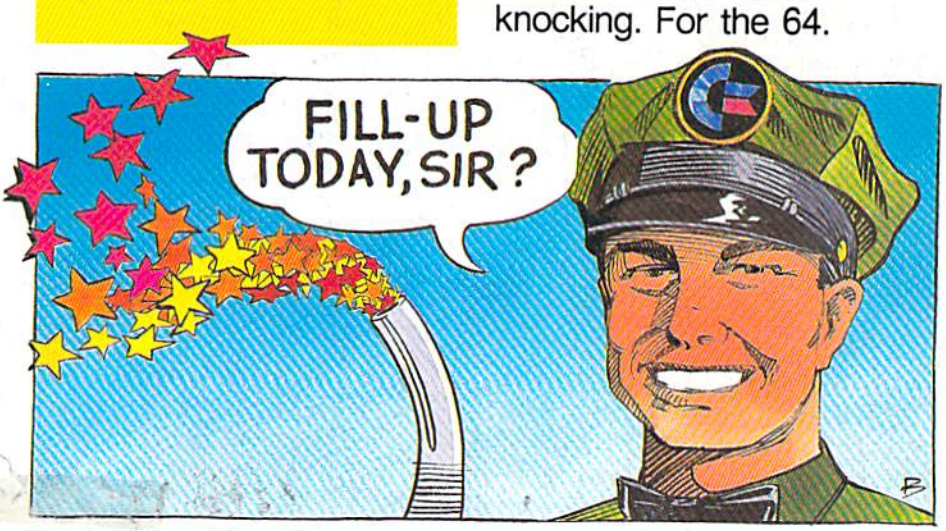

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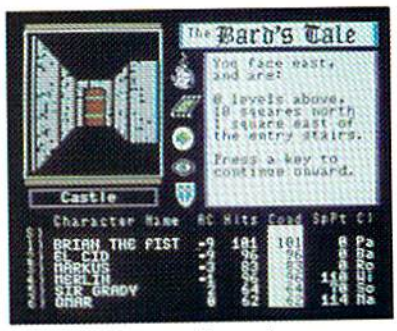

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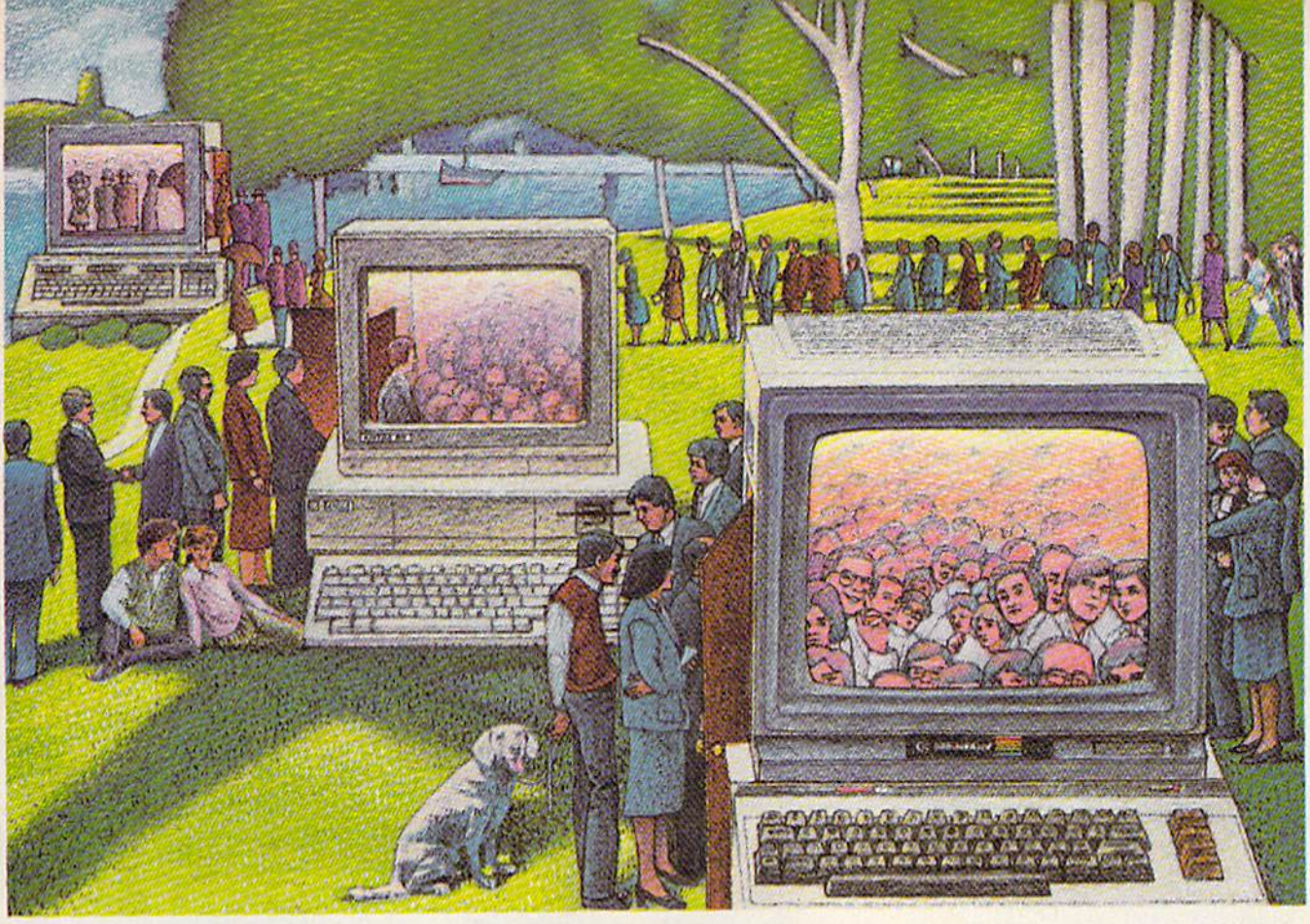

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editor's notes

Just in case you're not a regular reader of the financial news, we're happy to relate that Commodore International President Thomas Rattigan announced a net profit for Commodore in the fourth quarter ending in June 1986. Commodore net sales for the quarter were up 58 percent from the comparable quarter a year ago. Concurrently, Commodore Chairman Irving Gould pointed out that this net gain followed six consecutive quarters of losses. Rattigan also noted that the June quarter sales for the Amiga were the best since the computer's launch.

This is one set of quarterly reports that many have been anxiously awaiting. Commodore has been battered by the same weaknesses that have plagued the rest of the industry, as well as by Amiga sales that have been lower than anticipated. Conversely, Commodore 64 sales, and now 64C sales, have been consistently strong. Amiga sales, especially with the advent of international marketing, are showing continued improvement. Commodore has traditionally been quite strong in European markets, and has, in the past, been criticized for pushing products in Europe vigorously while soft selling their introduction in the U.S. With Amiga, Commodore apparently reversed the emphasis, and therefore only now is able to begin to draw on its reputation and sales in Europe after a slower than desired U.S. launch.

We continue to hope that Commodore will retarget the Amiga, or perhaps an Amiga-equivalent machine, at price points more system-competitive with the ST. Perhaps the newly introduced Apple IIGS will assist the Amiga, albeit in a convoluted way, by increasing interest in the market while helping highlight the significance of many of the Amiga features.

We digress. For now, a profitable quarter is significant. Let's go for back-to-back.

Looking Ahead

We're looking forward to another good year for the GAZETTE. As reflected in responses from you, our readers, we think we're providing the best coverage available for Commodore computers in each issue; 1987 will be no exception.

We have already scheduled several outstanding programs—utilities, games, and educational programs. You'll also see some excellent articles in our features section—hands-on tutorials that meet the needs of both beginning and advanced users and programmers. In an upcoming issue, we'll also have an exciting report on new technologies, showing the slow, but increasing merger of audio and video technologies with personal computers, much of this currently or soon available for eight-bit Commodore machines.

In addition, you'll find first-hand reports on the winter and summer Consumer Electronics Shows (CES), which promise to bring forth a host of new software and hardware products for the Commodore machines. There will also be articles on the latest computer printers and how to use them, updates on new developments in telecommunications, more information on the graphics and sound capabilities of the 64 and 128, and much, much more.

With computers as versatile and popular as the 64 and the 128, there's certainly no shortage of first-rate information and programs to be shared with our readers.

A Remarkable Success Story

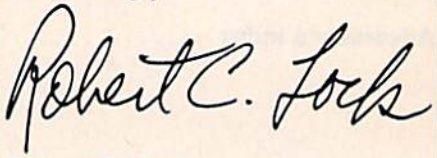
The continuing popularity of the Commodore 64—as shown most recently in healthy sales of the 64C computer—is a remarkable success story that's now approaching its fifth anniversary. Introduced in January 1982, the Commodore 64 offered a combination of graphics, sound, and computing power that was remarkable when first announced. Almost five years later, thousands of Commodore 64 owners are still finding new ways to use this versatile machine.

What's more, software companies both big and small have made commitments to continue producing Commodore 64 software for at least the next couple of years. Not only are these companies finding that the installed base of 64 and 128 users is just too big and active to ignore, but their own programmers and software designers are now coming out with some of the best 64 software ever produced. After spending more than four years learning the ins and outs of the Commodore 64 system, these programmers are working wonders that couldn't have been imagined when the 64 was first introduced.

Couple that situation with the fact that the Commodore 128 has turned out to be even more successful than Commodore officials thought it would be, and you've got a terrific environment in which the GAZETTE and its readers can operate.

One of the pleasures of publishing the GAZETTE each month is that we're constantly hearing from both experienced 64 and 128 owners—some who've read the GAZETTE from its first issue—as well as brand-new 64, 64C, and 128 owners. As always, the GAZETTE and its variety of readers create a synergistic effect that helps to keep the Commodore enthusiasm alive and well.

Stay with us—1987 should be an exciting year.



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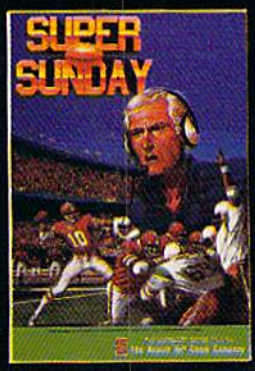
Editor in Chief

with Lance Elko
and Selby Bateman



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Corporate Offices:
825 7th Avenue, New York, NY 10019

Customer Service:
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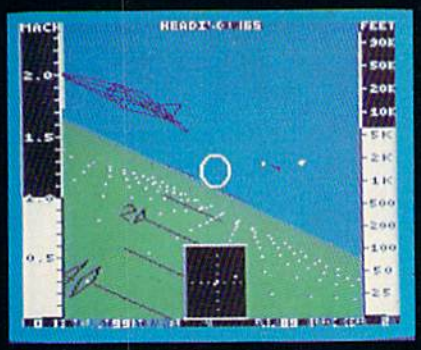
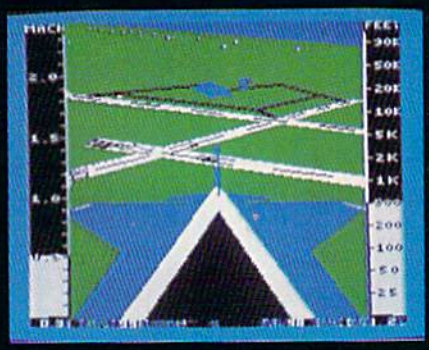


F-16 Dogfight with Enemy MiG-23 Fighters

F-18 on the Deck of a Nimitz-Class Aircraft Carrier (Control Tower View)



F-16 High-G Pullout over Detailed Wargame Scenery (Rear View)

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Do you have a question or a problem? Have you discovered something that could help other Commodore users? We want to hear from you. Write to Gazette Feedback, COMPUTE!'s GAZETTE, P.O. Box 5406, Greensboro, NC 27403. We regret that due to the volume of mail received, we cannot respond individually to programming questions.

A Good Idea For A Program

After many years of programming games on my Commodore 64, I've finally come up with a truly original idea for a game. My problem is I don't have the knowledge to write it. What I want to do is patent the idea, and then try and sell it to a software company. Have people done this before? Is there anything wrong with trying to do this? If not, how do I go about getting a patent for my idea?

Paul Rapnikas

Many software companies buy programs from outside programmers or development teams, but most wouldn't be very receptive to buying an idea for a program. It would be like sending an inquiry to a book publishing company asking if they'd like an idea for a story which one of their authors could write. You could write to individual companies and ask them if they are interested, but most—if not all—only buy the rights to completed programs.

You could copyright the game, but only after writing the program. Only a creative original work (a story, a song, a computer program) can be copyrighted. An idea cannot.

One thing you might consider is teaming up with a friend who could make your idea a reality. Or you could continue to program and hope that eventually you'll have the skills to write the game yourself.

Listing A Program To The Printer

I wrote a short program and would like to print it out after I run it, but I don't know how. Could you tell me how to print my program?

Martha L. Cox

While the program is in memory, type this line (make sure the printer is turned on before you press RETURN):

OPEN 3,4: CMD 3: LIST

This opens a channel to the printer (the file number is 3; the printer's device number is 4). If you'd prefer to see upper-/lowercase characters, use a secondary address of 7 (OPEN 3,4,7). CMD transfers output to the previously opened channel, so the listing is sent to the printer instead of to the screen.

When the program is finished listing, type this line:

PRINT#3: CLOSE 3

The PRINT# flushes out any characters that might remain in the printer and CLOSE shuts down the channel to the printer.

Returning To The Menu

Can you use the printer to print out the menu from the GAZETTE Disk? I'd like to place a copy of the menu on the front of each month's disk envelope.

Also, can you return to the disk menu program from a program without reloading?

LN Lambprice

A disk directory can be loaded and listed as if it were a program file. Type the following lines to list the disk directory of any disk to the printer (the diskname after CMD4 is optional):

LOAD "$0",8
OPEN4,4: CMD4,"*diskname*": LIST
PRINT#4: CLOSE4

If you load and list the directory from the GAZETTE Disk, you'll see the various programs for the 64 and 128, along with support programs and files such as the menu loader. If you'd prefer to see just the programs for the 64, type in the following short program, which reads the contents file on the disk and prints it to the screen. This is a generic file-reading program that will work on any files that contain ASCII characters:

```
FS 10 OPEN1,8,2,"64 CONTENTS"
AE 20 GET#1,A$:S=ST
MX 30 PRINTA$;:IFS=0THEN20
EK 40 CLOSE1
```

To read the file and send the results to the printer, use this program:

```
FS 10 OPEN1,8,2,"64 CONTENTS"
SM 15 OPEN4,4
AE 20 GET#1,A$:S=ST
QR 30 PRINT#4,A$;:IFS=0THEN20
RR 35 PRINT#4:CLOSE4
EK 40 CLOSE1
```

It would be possible to have most programs return to the menu after they're done, but there are several problems with this suggestion. First, the original idea for the Disk *was to provide exact copies of programs as they're listed in the magazine. The magazine listings don't return to a menu, so we'd have to make changes to the programs on the* Disk. *In some cases this would be simple enough, but other programs (especially ML games and utilities) rely on special programming techniques that add wedges, introduce interrupts, or move memory around. Before returning to the menu, the program would have to undo the various changes that had been made to the computer.*

Another factor is that many subscribers to the Disk *make backup copies—games on one disk, utilities on another, and so on. A return-to-menu command would generate error messages if the program was run from a disk that didn't contain the menu program. In the case of ML programs, it would be difficult for some of our readers to remove or rewrite the portion of the program that reloaded the menu.*

Adding the option of returning to the disk menu would please some subscribers, but it would displease many others.

The *SpeedScript* Buffer

I have a question about *SpeedScript*. Two of the commands deal with a buffer. The buffer isn't mentioned in the article, but the keyboard map shows the commands CTRL-R (retrieve buffer) and CTRL-K (kill buffer). Please explain how to insert text into the buffer and how to use these commands.

Chip Mattson

SpeedScript's erase command automatically activates the buffer. After you press CTRL-E, a prompt appears on the top line to ask whether you want to erase a sentence, word, or paragraph (press S, W, or P). Whatever you erase is temporarily saved in the buffer. To retrieve the text, press CTRL-R.

The buffer can be used in two ways. If you accidentally erase more than you wanted to, you can immediately retrieve it. Also, if you wish to move a section of a

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document, you can erase it, move the cursor to the new location, and press CTRL-R to insert it there. You can retrieve the contents of the buffer any number of times, which is handy for making repetitive forms (Name/Address/Phone, for example). Also, some (but not all) versions of SpeedScript allow you to erase part of a document, load a new file, and copy the buffered text from the first file into the second.

The text in the buffer will remain there until you use CTRL-E again, at which point the buffer is zeroed and the newly erased text begins to fill it. If you want to add to what's in the buffer, use SHIFT-CTRL-E instead.

When you're erasing large portions of a document, you may reach a point where there's no more room in the buffer. To clear out the buffer, press CTRL-K. You can then resume erasing.

The Meaning Behind CMD

In the September issue of the GAZETTE, *we said that the CMD statement doesn't seem to be an abbreviation and suggested that it doesn't have a long form. Readers R.S. Heyer and Jim Yost both sent letters with the same answer: CMD means* Change Main (output) Device, *which makes sense to us. Thanks for your letters.*

Moving Files Around

How can I reposition files on a disk directory so that an often-used program is the first on the disk? This would be useful in loading programs with just an asterisk (*).

David Marz

First, the asterisk doesn't always load the first program on a disk. If you have just loaded or saved a program and then type **LOAD"*",8** *you'll load the most recently accessed file—not the first on the disk. This is handy if you accidentally scratch a program. A scratched file is the most recently accessed, so you can* **LOAD"*",8** *to retrieve it and then save it back to disk.*

To load the first file on a disk, enter **LOAD"0:*",8**. *Usually the shorter* **LOAD":*",8** *will also work.*

You can replace the first disk file with another file by using the DOS copy command in conjunction with the rename and scratch commands. Let's say you have a disk that contains ZEBRA as the first file and you'd prefer to have another program called AMBER at the beginning. First, you have to move ZEBRA out of the first position:

```
OPEN 15,8,15
PRINT#15, "C0:TEMP=0:ZEBRA"
PRINT#15, "S0:ZEBRA"
PRINT#15, "R0:ZEBRA=0:TEMP"
```

First, copy (C0:) the file named ZEBRA to a temporary file on the same disk called TEMP. At this point, the same program is on the disk in two places, once as ZEBRA and once as TEMP. Next, scratch (S0:) ZEBRA, which frees up the first spot in the directory. Finally, rename (R0:) the file TEMP to its original name of ZEBRA. Now you have to copy AMBER to the newly opened first position in the directory:

```
PRINT#15, "C0:TEMP=0:AMBER"
PRINT#15, "S0:AMBER"
PRINT#15, "R0:AMBER=0:TEMP"
CLOSE15
```

This copies the file AMBER to the next available space in the directory (which happens to be the first filename, because ZEBRA was just moved). Then the original AMBER is scratched, and TEMP is renamed to be AMBER. Finally, channel 15 is closed. Now, when you enter **LOAD"0:*",8** *you'll get the AMBER program because it's the first one in the directory.*

Arrays Are Lists

Could you write an article about the use of the DIM statement? The reference books I own have very sketchy information. I've enclosed a partial listing of a program I'm trying to write for our bowling team. I keep getting an error message in the line that contains DIM. Any help would be appreciated.

A.G. Trobaugh

The DIM statement sets up the size (DIMension) of an array of variables. An array is basically a numbered list of variables. The array has a single name, like a variable, but it is followed by an index number in parentheses. Arrays are useful in a wide variety of applications. You can create arrays to contain strings or numbers, and they may have one or more dimensions.

From the program listing you sent, it looks like you understand how to use ordinary variables. And there are sections of the program that would benefit from the use of arrays. For instance, there's one part of the program that looks like this:

```
310 INPUT NM
320 IF NM = 1 THEN NM$ =
    "DOROTHY"
330 IF NM = 2 THEN NM$ = "NESSY"
340 IF NM = 3 THEN NM$ = "WALLY"
```

and so on, with a total of eight IF-THEN statements. This is a situation that could be handled very nicely with an array. There are eight names, so you need to DIM the array to a size of 8, and then assign the names to each position in the array:

```
10 DIM B$(8)
12 B$(1) = "DOROTHY": B$(2) =
   "NESSY": B$(3) = "WALLY"
```

The rest of the array is then filled with the appropriate names. A shorter way to set up the array is to use a FOR-NEXT loop:

```
10 DIM B$(8)
12 FOR X = 1 TO 8: READ B$(X): NEXT
14 DATA DOROTHY, NESSY, WALLY
```

The DATA statement on line 14 must contain eight names for this to work properly. Note that line 12 uses a variable instead of a number in parentheses. You can put either a number or a numeric variable in parentheses. This means you could replace the INPUT and eight IF-THENs starting at line 310 with the following two lines:

```
310 INPUT NM
320 NM$ = B$(NM)
```

A two-dimensional array needs two numbers (or variables) in parentheses. Let's say you want to keep weekly scores for each of the bowlers on the team. On paper, the grid would look like this:

NB ▼	NW ▶ WEEK 1	WEEK 2	WEEK 3
BOWLER 1	660	639	591
BOWLER 2	501	505	542
BOWLER 3	482	595	403
BOWLER 4	...	...	...

The number of bowlers (NB) runs down the left side, and the number of weeks (NW) runs across the top. To implement this in BASIC, you need a line like this:

```
10 NB = 8: NW = 33: DIM SC(NB,NW)
```

You also need a way to fill up the array with the appropriate numbers, whether you INPUT from the keyboard, READ from DATA statements, or OPEN and READ a disk file.

There are two problems in the line that's giving you the error message. The first is that DIM should be followed by the array name and parentheses containing the size of the array (see the examples above). Another, more serious, mistake is that there are several DIM statements sprinkled throughout the program. An array can be dimensioned only once. If you use DIM more than once on the same array, you'll get a REDIM'D ARRAY error. A common practice is to put all DIM statements at the beginning of a program or in a subroutine that's called only once.

Exception To The Rule?

In one of your programs, you used negative numbers in DATA statements. I don't understand that. I thought all DATA statements were between 0–255. How does this work?

Glenn Peterson

Three of the most common uses for DATA statements are machine language programs, custom characters, and sprite

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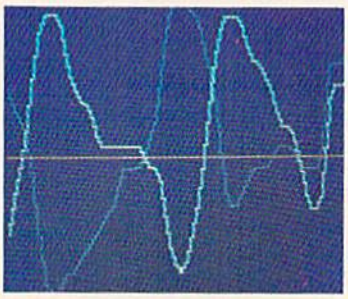

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shapes. All three of these require numbers to be POKEd into memory. An individual byte of memory can hold a number in the range 0–255, so in a sense you're right. When DATA statements hold numbers that are going to be POKEd into memory, the DATA statements must be limited to the range 0–255.

But DATA statements can hold other sorts of information, too. If the data is names of people or bowling scores, the 0–255 rule doesn't apply. Negative numbers are acceptable in DATA, as long as the numbers aren't being POKEd to memory.

How Much Room Remains On The Disk?

I have a program to control a loan business. Each account is kept as a sequential file. The individual file lengths vary from account to account, and it's sometimes necessary to ascertain how much space is available on the disk. It would not do to suddenly run out of space.

Could you provide a BASIC subroutine that would allow me to read at any time the number of blocks free on a disk?

Ralph Greenhalgh

The following program does what you're looking for:

```
EE 10 Z$=CHR$(0)
KC 20 DEFFNA(X)=ASC(A$+Z$)+256
      *(ASC(B$+Z$))
KC 25 PRINT"CHECKING DISK, PLE
      ASE WAIT"
RC 30 OPEN1,8,0,"$0"
BE 40 GET#1,A$,B$
HB 50 GET#1,A$,B$:IF FNA(X)=0
      {SPACE}THEN 90
BJ 60 GET#1,C$,D$
BE 70 GET#1,E$:IF ASC(E$+Z$) T
      HEN 70
DG 80 GOTO50
SJ 90 A$=C$:B$=D$:F = FNA(X):C
      LOSE1
XS 100 PRINT F, "BLOCKS FREE O
       N THE DISK"
```

After the routine is finished, the number of blocks free will be in the variable F (see line 90).

Sprite Collisions And Hi-Res Graphics

I have two computers, a VIC and a 64. I've been writing machine language programs for both of them for about a month now. How can I write a program that detects collision between a certain sprite and a certain background character in machine language? Say a program that checks for collision between sprite one and the letter R and a collision between sprite two and the letter A.

Another question. I have a game that displays 16 colors in bitmap (hi-res) mode. How is this done?

Sayam Tantasook

When a sprite-to-character collision occurs, you can PEEK location 53279 ($D01F) to determine which sprite was involved in the collision, but there's no easy way to figure out which character it hit. All you really know is that a certain sprite happened to hit a character. You can't determine which character was hit unless you PEEK the horizontal and vertical locations (x and y coordinates) of the sprite, translate them into the equivalent row and column on the screen, and then PEEK screen memory in that vicinity.

To answer your second question, there are several ways to set up a hi-res screen. The first is true hi-res, where you can turn on or off 64,000 picture elements (pixels) arranged in a pattern of 320 pixels across × 200 pixels down. Since a byte of memory contains eight bits, it can hold enough information to control eight pixels on the hi-res screen. Thus, 8000 bytes are required to bitmap a standard hi-res screen.

Color memory is also important. When you set up a hi-res screen, 1000 bytes are set aside for color memory. Each memory location in hi-res color memory controls the foreground and background colors for an 8-pixel × 8-pixel section of the screen. Within each 8 × 8 section, you're allowed only two colors (not counting sprites that might be moving around). But each section is independent of the other sections. So, for example, you could have an 8 × 8 chunk of the screen with a blue background and white pixels next to a section that has a red background with gray pixels. Each 8 × 8 area can contain only two colors, but the colors are independent of colors that might appear in other 8 × 8 areas.

Another method to set up a bit-mapped screen is to use multicolor hi-res. If you choose to use multicolor mode (which could be called medium-res), you trade half the horizontal resolution in return for two additional colors. Instead of 320 × 200, the screen has 160 double-width pixels × 200 lines. Each pixel requires two bits (binary 00, 01, 10, or 11) to define the color. Color memory still controls an 8 × 8 section of the screen, but the pixels are twice as wide, so you really have only a 4 × 8 area to work in. The 32 pixels can contain one of four different colors. Again, the separate sections of the screen are independent of each other, although one of the colors is universal.

Some screens that seem to be hi-res actually use custom characters. Each character can have an individual foreground color (based on the number in color memory) in addition to a background color shared among all characters. Multicolor characters can have an individual foreground color plus two other common colors in addition to the background.

Characters can also be displayed in extended background color mode, which reduces by a factor of four the number of available characters (64 instead of 256), but multiplies by four the number of background colors. You can then choose one of the 16 available colors for the character in the foreground and one of four background colors for the rest of the 8 × 8 character grid.

Pictures On Disk

I recently purchased a Commodore 128. One of the main reasons I chose the 128 is because I heard of its easy-to-use graphics capabilities that are accessible from BASIC. I have written many hi-res programs and wish to save just the pictures to disk, preferably with the BSAVE command. Is this possible? How could I do it?

Brian Aljian

After you've designed the hi-res picture and displayed it on the screen, type the following line in immediate mode—or include it in your program:

BSAVE "*picturename*", B0, P7168 TO P16383

*To load it back into memory, **BLOAD"picturename",B0**. For multicolor hi-res pictures, you'll have to set colors 2 and 3 before BLOADing the picture.*

BLOAD and BSAVE were intended primarily for machine language programs, but they can also be used to load and save hi-res pictures, sprite shapes, character sets, function key definitions, and so on. If you have a portion of memory you want to send to disk, BSAVE is a handy command.

The Other Side Of The CP/M Disk

I'm a Commodore 128 owner, and I was unaware that the CP/M disk was two-sided until I read about it in your magazine.

After I booted it for the first time and before I copied it, I managed to "nuke" the disk. Now, the first side still boots up, but the second side gives me a disk error and prints a whole bunch of question marks.

What happened to my disk and how can I get it replaced?

Jim Traverse

The first side of the CP/M disk contains the boot sector for starting up CP/M and the second side does not. You must turn on the computer (or type BOOT) while side one is in the disk drive. After CP/M has booted, remove the disk and flip it over.

When the second side is in the drive, type DIR to see if you can get a directory. If you still get question marks, try pressing CTRL-C (hold down the CONTROL key and press C). This tells CP/M to log out the previous disk and prepare for a new one. Then type DIR again. Pressing CTRL-C may solve your problem.

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If the disk is defective, it should be covered by the warranty. See the DRI licensing agreement that came with the disk. It says that defects in the media (meaning a disk that doesn't work) are covered and you can return the disk for a replacement.

Addressing Envelopes

I have a Commodore 64 with a 1526 printer. I routinely use *SpeedScript* for letters with tractor-feed paper. I have trouble with regular single sheet paper and I have been unable to type envelopes. How do I do this?

George A. Clark

When you're using SpeedScript *with single sheets of paper, you should put the page-wait command at the top of the document. Hold down CTRL and press the English pound key. You'll be prompted for a format key; type the letter* w *(for "wait between pages"). You may have to set the bottom margin a little higher as well. When a page has printed,* SpeedScript *will print a line that reminds you to insert the next sheet.*

The Commodore 1526 printer has a paper sensor that causes the printer to stop when it thinks it has run out of paper. By using the page-wait command, you can avoid most problems caused by the sensor.

The printer won't print envelopes because of the paper sensor. When you've lined up the envelope, the printer thinks it's out of paper and refuses to continue.

Here's a way to use your printer to address envelopes: Place a piece of paper between the flap and the main envelope. Carefully pick up the paper and envelope together and insert them top first into the printer. Advance the paper until the top of the envelope shows. The piece of paper you've inserted fools the paper sensor into thinking there's more paper.

A *Fastload* Warm Start

I am a happy owner of the Epyx *Fastload* cartridge, but when I use the 64's system reset command (SYS 64738), *Fastload* is disabled. Is there a reset command that will leave *Fastload* in place?

Brian Johnson

We don't usually respond to programming questions about specific commercial products (it's best to address inquiries to the software company that produces the program), but within a week after we received your letter, two answers appeared in the "Feedback" mailbox, so this must be a common problem. Here they are:

> *The* Fastload *manual states that the only way to use the cartridge after it has been deactivated is to turn the 64 off and on again. However, through disassembling the program I have figured out how to do both a warm start and a cold start.*
>
> *The warm start is easy; all it does is re-enable the* Fastload *commands without clearing the screen or erasing any program in memory. Just SYS 57194. The cold start is similar to SYS 64738 but also enables* Fastload. *Below is a program that does it. The variable S can be set to any value where there are 6 free bytes of memory.*

```
10 S=820
20 FOR I = S TO S+5: READ A:
   POKE I,A: NEXT: SYS S
30 DATA 32,6,223,76,48,128
```

David MacKenzie

> *I'm sure* Fastload *users have found that SYS 64738 doesn't reset* Fastload. *This short routine can replace SYS 64738:*

```
10 FOR I = 288 TO 293: READ A:
   POKE I,A: NEXT
20 DATA 32,21,223,76,61,128
```

> *After you run the program, you can reset the computer and re-enable* Fastload *with SYS 288.*
>
> Albert H. Cooper, III

Thanks to both of you for the answer to this question.

80-Column Cables For The 128

I would like to know where I may purchase the monochrome 80-column cable that you mentioned recently, and how much it is.

Ricky Seidenstein

The 128 has both monochrome and color 80-column outputs. These two signals are available on the port labeled RGBI. To see 80 columns in color, you need an RGB monitor and an IBM-compatible color cable (almost any merchant that sells RGB monitors will also stock cables for the IBM, so they're not difficult to find).

You can use either a monochrome monitor, also called a green-screen or an amber-screen, or a composite color monitor such as the 1701 or 1702 to obtain 80 columns in monochrome. For the 1701 or 1702, connect the monochrome input to the jack on the rear of the monitor labeled LUMA. Monochrome means one color, *but you really have three colors: dark, light, and a gray shade that's between the two extremes.*

To build your own cable, buy a length of coaxial cable, an RCA male plug, and a standard male nine-pin D connector (Radio Shack part #276-1537). The nine-pin connector is the complement of a joystick connector, which is to say that a joystick plug will fit into this connector. Pin 1 of the RGBI connector is ground and pin 7 is the monochrome output. See page 352 of the 128 System Guide *for a diagram, which is arranged as if you were inside the computer looking out. Connect pin 1 to the outside portion of the coaxial cable and pin 7 to the inner wire.*

The Radio Shack parts cost about $5, and the cable is easy to make if you're good with a soldering iron. If you're not, you can buy one for $8–$15. Batteries Included, Microvations, and Cardco have such cables for sale (ask your local Commodore dealer for details). Some Commodore dealers also make their own cables.

XMODEM: A Standard Protocol

Where can I obtain the XMODEM protocol? I am interested in designing my own terminal programs and need information on this.

Tim Kollas

XMODEM (also known as Modem7) is an error-checking scheme used to transmit files from one computer to another, usually over the telephone lines. It is without a doubt the most popular microcomputer protocol for uploading and downloading.

The original XMODEM protocol was devised by Ward Christensen, who also set up the first computer bulletin board. Data is sent in blocks of 128 bytes, with a checksum and other extra information which insures that each block is received correctly.

XMODEM transfers always involve eight-bit bytes; if you are using a telecommunications program, make sure that you are communicating with a word length of eight bits and no parity. Four ASCII characters have a special meaning in this protocol:

1	*SOH*	*start of header*
4	*EOT*	*end of text*
6	*ACK*	*acknowledge*
21	*NAK*	*negative acknowledge*

The computers at both ends of the link use these characters as signals during the transfer. Respectively, they are used to mark the start of a data block (SOH), and to indicate when the transmission is complete (EOT), when a block has been received successfully (ACK), and when an error has occurred in receiving a block (NAK).

A complete XMODEM block always consists of 132 bytes of information. The first 3 bytes of the block are called the header. The next 128 bytes contain the actual data being transferred, and the last byte contains a checksum. The first byte is the start-of-header character (SOH, ASCII 1) which says to the receiving computer, "Here comes a block." The second byte is the block number, which begins at one and increases by one every time a block is successfully transmitted. When the block number exceeds 255, it flips over to zero (not one). The third byte is the block complement, a value equal to the ones complement of the block number (256 — the

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Take the evaluation of Senior Editor David Martin, in *Private Pilot* magazine's August 1986 issue. Martin, a former Navy aviator who has flown almost everything with wings, reviewed five MicroProse programs, including the bestselling SOLO FLIGHT primary flight simulator. "I'd not have believed it possible . . ." he wrote, "Pilots of all sorts will be fascinated by these aviation games."

Mr. Martin isn't the only pilot who's spent many of his recent leisure hours with MicroProse simulations. Comparing his experience in training real flyers with the instrument layout found in SOLO FLIGHT, Cessna Flight Instructor Mark Rice told us "the instrument flying segments are very similar to the real thing – you're up in the clouds and using your readings to guide the aircraft."

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block number). Together, the block number and complement allow both computers to make sure they are synchronized (dealing with the same block).

The 128 data bytes may contain any sort of eight-bit data (executable programs as well as ordinary ASCII text). The checksum is the eight-bit sum of all 128 data bytes. It's reset to zero at the beginning of each block, and flips over to zero whenever it exceeds 255. In BASIC, the checksum can be calculated with the statement CHECKSUM = (CHECKSUM + BYTE) AND 255, where CHECKSUM is the checksum value and BYTE is the ASCII value of the current character. Here is a nutshell description of a successful XMODEM transfer:

Initiation. Sender waits for an initial NAK from receiver. Receiver sends a NAK to initiate the transfer.

Transfer of blocks. Sender transmits a 132-byte block consisting of a one-byte SOH character, one-byte block number, one-byte block number complement, 128 bytes of data, and a one-byte checksum. If the receiver gets the block successfully, it sends an ACK to say, "I got that block okay; send the next one." If an error occurs, the receiver sends a NAK to say, "Send the last block again." This process continues until all blocks have been received successfully (or the transfer is aborted; see next section).

Termination. Sender transmits an EOT character to signal the end of the transmission. Receiver sends an ACK to say, "I see that you're done, so I'm quitting, too."

Timing and error-checking are critical parts of XMODEM. Since the transfer is largely automatic, each computer must have a means of aborting the process if too many errors occur. Here is a description of error-checking during an XMODEM transfer:

Initiation. Sender aborts the transfer if it doesn't receive an initiating NAK from the receiver after ten 10-second timeouts (100 seconds total). Receiver sends the first NAK, then waits to get the first SOH, sending another NAK every ten seconds if no SOH appears. Receiver aborts the transfer if ten 10-second timeouts occur without its receiving an SOH.

Transfer of block. Sender transmits a 132-byte block, then waits for a response from the receiver. Sender aborts transfer if ten 10-second timeouts occur for any block without its receiving an ACK or NAK from the receiver. Receiver waits for each block to arrive, sending a NAK every ten seconds if no SOH appears, and aborting transfer if ten such timeouts occur for any block. After receiving an SOH, the receiver reduces the timeout interval to one second for each of the 131 remaining bytes in the block, and sends a NAK to request retransmission if more than ten 1-second timeouts occur for any single byte (this covers the case where a block contains too few bytes). If all 132 bytes arrive on time, the receiver sends a NAK if the first byte is not an SOH or if the block number, complement, or checksum does not match. If the receiver gets a duplicate block (caused when the sender fails to recognize an ACK), it throws away the duplicate and sends an ACK to say, "I got that block already; send the next one." In this case, and whenever it needs to send a NAK, the receiver first purges the line by getting the remainder of the block (getting characters until no more characters are incoming) and throwing it away.

Termination. If the sender's EOT is lost, or the sender simply stops sending, the receiver eventually aborts because it experiences ten 10-second timeouts without receiving anything. If the sender does not receive the receiver's final ACK, it aborts when ten 10-second timeouts occur. Note that if the very last block of data contains fewer than 128 bytes, the sender "pads" the block with extra characters, often nulls (ASCII 0).

Though it's not provided in the original protocol, many implementations of XMODEM use another special character (CAN, ASCII 26) to allow either computer to cancel the transfer immediately. Proponents of XMODEM claim an accuracy rate in excess of 99 percent (fewer than 1 percent undetected errors). XMODEM was devised in the early days of personal computing, when the eight-bit CP/M machine was king. Its major limitations arise because, understandably enough, it relies on eight-bit arithmetic. An improved version of XMODEM uses the CRC (cyclic redundancy checksum) method to reduce the likelihood of undetected errors. Programs designed for use with commercial information services often relax the timing requirements (increase the timeout periods) as well, to allow for the delays caused by telephone packet-switching networks.

XMODEM has also been criticized because it involves a high degree of overhead: For every 128 bytes of data, you must process a minimum of five non-data bytes (SOH, block number, complement, checksum, and ACK or NAK). More recent protocols such as Kermit transmit data in 1024-byte or even larger blocks.

Video Banks

I am in the process of writing an arcade-style game for the 64 which uses both sprites and hi-res graphics. Unfortunately, I have more than 50 sprite shapes, so the shapes and the hi-res screen cannot be located in block zero. I haven't been able to find out how to move sprites and the hi-res screen to block one. The screen memory and character memory must be moved also. Do the sprite pointers change from 2040–2047 to 18424–18431? Since my game is in machine language, the placement of BASIC is not a problem. Can you help?

Dean Kreutzer

The VIC-II video chip handles all graphics, including sprites, hi-res screens, character shapes, and screen memory for ordinary characters. This chip can only "see" 16K at a time, so you can choose from four video banks:

bank 0: 0–16383
bank 1: 16384–32767
bank 2: 32768–49151
bank 3: 49152–65535

When you switch to a new video bank, all video information moves there. If you have a character screen at locations 1024–2023, with sprite pointers at 2040–2047, and you move the video to bank 1, the new sprite pointers will be located at 18424–18431.

To switch to a new bank in BASIC, use the following lines (where BANK is the bank number):

```
POKE 56578, PEEK(56578) OR 3
POKE 56576, (PEEK(56576) AND 252) OR
  (3-BANK)
```

The machine language equivalent, assuming you want to switch to bank 1, is:

```
LDA 56578
ORA #3
STA 56578
LDA 56576
AND #252
ORA #2
STA 56576
```

*You won't be able to print to the standard text screen unless you also POKE 648, (PEEK(648)AND63) OR (BANK*64).*

All programs listed in this magazine are available on the GAZETTE Disk. See details elsewhere in this issue.

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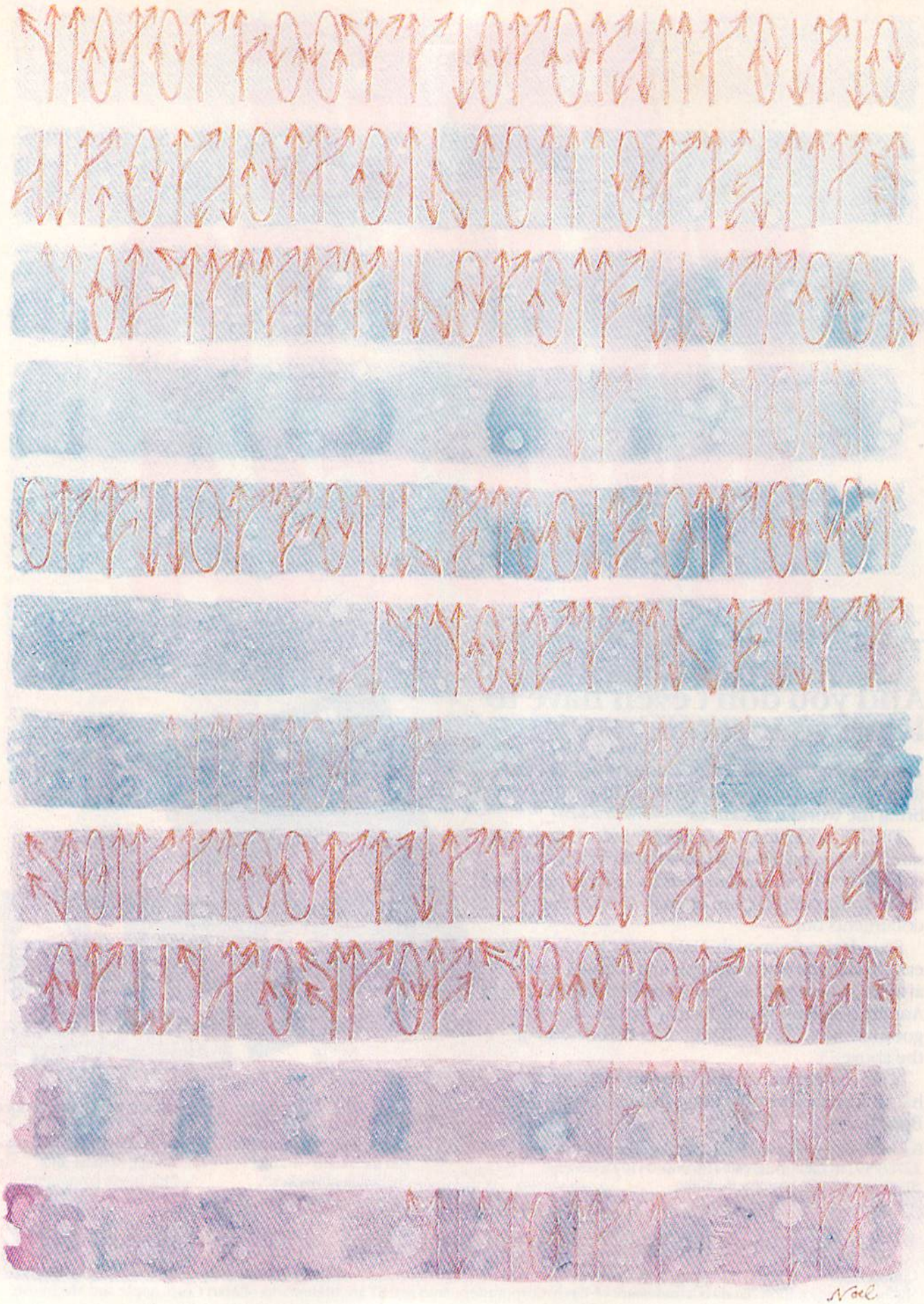


The Evolution Of Program Design

Selby Bateman, Features Editor

Will individual programmers be replaced by teams of program designers, each with his or her own specialty? It's been happening for years in the mainframe and minicomputer environment, and is fast becoming the norm in the microcomputer programming world. As computers grow more powerful, software becomes more complex—and programmers often find themselves with too much of a good thing.

Veteran program designer Chris Crawford remembers leaning over his KIM-1 single-board microcomputer in 1977, trying to program a game that would run in the machine's 1K of Random Access Memory (RAM); that's *1,000 bytes of total memory*—1/64 the RAM of your Commodore 64 and 1/128 that of the Commodore 128.

"I was sweating every bit, packing every bit; fitting it into RAM was the dominant consideration," says Crawford. "It's largely opaque to the user, but programmers have always sweated RAM."

He succeeded in finishing the game, and in the process learned a great many lessons about efficient program design and execution.

Less than ten years later, Crawford is now working on a computer with 512K of RAM, designing a game that will operate only on computers with a minimum of 256K of memory. That mushrooming growth in available memory is the trend that Crawford says has most dramatically affected his work and that of every other program designer today.

Running Away From Us

At the same time that he and other programmers are enjoying this expanded memory, Crawford issues a warning: "Basically, the hardware is running away from us."

To understand that cautionary note, consider Crawford's own history in the programming business—a tenure that surpasses that of most other programmers in duration and success.

After working in the impossible space of 1K in 1977, Crawford moved up to 8K in 1978 with his first commercial game, *Tanktics*, then jumped to the then unheard-of 16K in 1981 with his popular game, *Eastern Front*. Another game, *Excalibur*, was created in 1983 to run on a machine with 48K. His recent highly acclaimed *Balance of Power* requires 128K of memory. And now he's in the midst of designing a game that requires 256K to operate.

In the days when he had little RAM to work with, Crawford discovered what many other programmers—professional and amateur hackers alike—have since learned. When you want to squeeze a good program into a small space, you have to write your programs in machine (assembly) language.

So-called high-level languages like BASIC and Pascal are fairly large programs, which use up a lot of memory themselves. So, Crawford and many others studied machine language, and discovered the thrill of communicating one-to-one with the computer. While the task was not a simple one, the programs were small, fast, and elegant.

But when Crawford began to climb up to computers with larger memories, he quickly found a different problem.

"In small machines, you had to work in assembly language to accomplish much," says Crawford. "But when we got to 48K, it got a little rough to do everything in assembly language.

"For me, the big transition was going to 128K in *Balance of Power*. I worked in Pascal. It's difficult to imagine someone writing a 128K program in assembly language. Although people do it, it's very hard."

The *Real* Problem

And something else began to happen. A few programmers noticed that the extra memory was making some programmers lazy—wasting all of that formerly precious memory by writing sloppy code. For example, a word processor that previously would have been

squeezed into 20K when written in machine language might now be written in a high-level language like C, taking up 100K or more of memory.

But, says Crawford, that's not the *real* problem. All of this extra memory is cheap. It's the quality of the program itself that's suffering today, he adds.

"Wasteful memory? That's not so much a problem. Do you waste paper clips in your office? Big deal," says Crawford with a laugh. "The more serious problem is that programmers have had problems adjusting to the new RAM sizes, and using them effectively."

When it comes to today's program design, Crawford is concerned with what he calls the difference between meat and meat extender. In earlier days, a 30K program might have had 12K of actual program (the meat) and 18K of data (the meat extender). Today, Crawford is seeing programs with 40K of real programming and 500K of meat extender.

"They spend a lot more time throwing little nothings at the user, but the programs aren't much different. Programmers are shoveling a lot of filler into their programs—meat extenders."

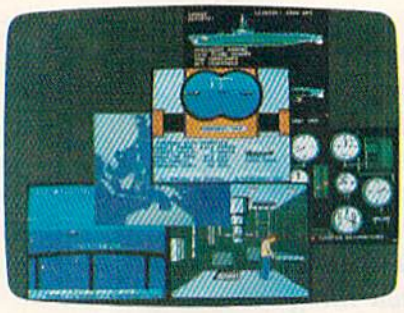
On the happier side of this equation, Crawford sees this as a temporary aberration. But, one that will change over time only slowly.

Emerging Design Teams

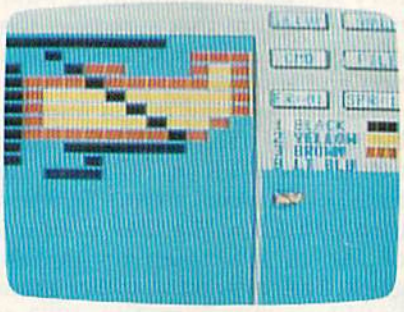
How are commercial program designers coping with this problem? For several good reasons, the enormous changes in available memory and much more powerful and flexible computer systems have given rise to software design teams. Programmers, graphic artists, testers, project directors—all work together to create the best possible program. These teams also use a host of programming tools, usually built up through earlier projects, which become a virtual library of programming tricks and timesavers.

Sid Meier, who has designed or directed the design of virtually all of MicroProse Software's popular simulation and strategy games, says that MicroProse uses an interactive

The excellent visual effects in such Epyx computer games as Summer Games II *are created by computer art director Michael Kosaka and his team of four artists.*



Although Sid Meier's popular flight simulators and air combat software have been based on his own development libraries, he started from scratch when creating the screens for the MicroProse submarine simulation, Silent Service.



Garry Kitchen's GameMaker *package includes a SpriteMaker among its arsenal of programming tools for nonprogrammers.*

development language that includes many proven machine language routines and that was created internally for the company's own use. This library of development tools is composed of building blocks, everything from a static background to sound and sprite programming routines from earlier games the company has produced. "It lets you develop interactively without the hassles of machine language."

Meier is responsible for such hits as *Solo Flight*, *F-15 Strike Eagle*, and *Silent Service*, in addition to designing the company's Command Series of strategy games. He's been a part of many changes that have made his teams of designers more effective.

"For instance, the standards and levels of artwork required have improved dramatically," he says. "Generally today, you need an artist, or someone competent to do the graphic part of the program."

Another example of shared responsibilities is the MicroProse Command Series, including titles such as *Crusade in Europe*, *Conflict in Vietnam*, and *Decision in the Desert*. While Meier may do much of the actual program design, it's MicroProse resident historian Ed Bever who conducts the research to make sure that the final product design is as accurate as possible in a game. They work as a team, bringing together talents that would be difficult to find in just one designer.

The Feel Of The Game

At Strategic Simulations (SSI), a leader in strategy and fantasy games, the development teams are a mixture of talents as well. For example, Paul Murray worked with co-designer Keith Brors to create the fantasy game *Wizard's Crown*. The approach they took with that game is similar to any program they might tackle, says Murray.

"The first thing we do is to come up with what we want the game to do, what the feel of the game is. And then we write the rules. The emphasis from the start in *Wizard's Crown* was on tactical combat.

"We came up with the basic algorithm, tested it to see if it worked,

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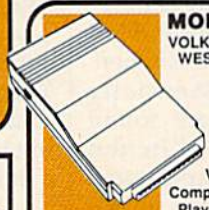

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then started doing the general stuff," he says.

While Brors worked on the characters and the data surrounding them, Murray concentrated on working out the combat situations. Later, the two put together what they'd worked out individually, but the entire process was one of constant interaction. Even SSI President Joel Billings, who has extensive experience as a war gamer and a game designer, gets involved as a tester and fine-tuner in the SSI development process.

Computer game enthusiasts today usually demand exceptionally well developed color graphics. To answer that need, one of the changes in program design is the emergence of the art director, whose job it is to make sure that the computer graphics are as effective as possible. At Epyx, a company known for its graphically excellent action games, Michael Kosaka serves as art director for computer graphics.

Managing a staff of four other artists, Kosaka works with individual project managers and programmers, trying to get the right mix of graphics and game play. Like a number of other companies, Epyx' designers build many products with in-house development tools. Kosaka even has a set of graphics tools that let him create any images he wants without having to be an expert in machine language.

Thrashing Things Out

"I think my goal is to try to get the absolutely best images I can," he says. And he admits that part of what he likes most about his work is "thrashing things out with the programmers, working with them, pushing and learning from them.

"It's very interesting. We've found a nice blend of give and take, and it works out real well."

Kosaka also works with programmers who may be hundreds of miles away. As a game designer and an artist himself, he sends samples of sprites and storyboards to the programmers for their development. Then, once the programming itself has started, Kosaka and the programmers go back and forth deciding what's possible to accomplish.

He's seen the way that today's computers, especially the Commodore 64, can produce results far beyond what programmers just two years ago felt were possible. "It's fascinating. It's the same basic machine, but a lot of new things are going on with it. And a lot of that is experience, hacking away at it."

Garry Kitchen is another successful program designer who's made a transition from working alone to working with a co-designer. After creating Activision's *The Designer's Pencil* by himself, Kitchen began work on what was to become the popular *GameMaker* program.

GameMaker is a package that lets the nonprogrammer create workable, stand-alone action games, including sprites, sound effects, music, and background scenes. Just as commercial program designers now use their own development libraries and refined tools, *GameMaker* lets the nonprogrammer have much the same thing—only less powerful.

"The *GameMaker* code is probably 150K; it takes up almost all of one side of a disk," notes Kitchen. Since *GameMaker* is essentially composed of five separate sound and graphics modules, Kitchen brought in programmer and musician Alex DeMeo to create the SoundMaker and MusicMaker sections of the program. All five modules must work together, so Kitchen and DeMeo had to carefully design and program each section.

"It's increasingly difficult to work alone with that much memory," says Kitchen. "You have to generate vast amounts of assembly language code."

Nevertheless, Kitchen has not made the jump to a high-level programming language such as Pascal or C. He prefers to stay with machine language despite the rigors such a course involves with large programs. "I'm always dedicated to maxing out the hardware. If I write a program in assembly language and someone else writes in C, my program will be better."

What's more, Kitchen's current project, a new game, is so far a solo effort. He admits, however, that he may bring in some help on the graphics work.

A Monk In A Monastery

Chris Crawford maintains that there's still plenty of room for the program designer who's willing to invest thought and energy. In fact, he's convinced that it's this type of programmer who will, in the long run, prevail. And that includes programmers working alone as well as design teams. Crawford, who is continually studying the evolution of computer programming, is the author of the book, *The Art of Computer Game Design: Reflections of a Master Game Designer* (Osborne/McGraw-Hill).

"The fundamental question here is, What is programming? We're in the middle of a transition from one regime to another. The first regime is the monk in the monastery copying a manuscript—the programmer does what the computer does well," says Crawford.

"The new regime is programming as an act of communication: The emphasis is on what we should say. People will become bored with communication that says nothing. That's rather like opening a book that has an illuminated manuscript, but is nothing more than 'Mary had a little lamb'—not saying anything.

"I take a generally optimistic view over the long term, but less in the short term," he adds. "When I take the long view, I can certainly say that the top ten products of 1986 are better than those of 1983. There are a lot of weeds in the garden, but they're not choking out the roses."

Whatever the course of program design, it's obvious that computers will always attract individual programmers like Crawford and Kitchen. Even with microcomputer memories quickly approaching one, two, and four megabytes, there will be designers who prefer a solo approach to programming tasks. But, just as clearly, commercial software for microcomputers is now reaching a point where the combined talents of a group of programmers can be a potent force in bringing new products to the software marketplace.

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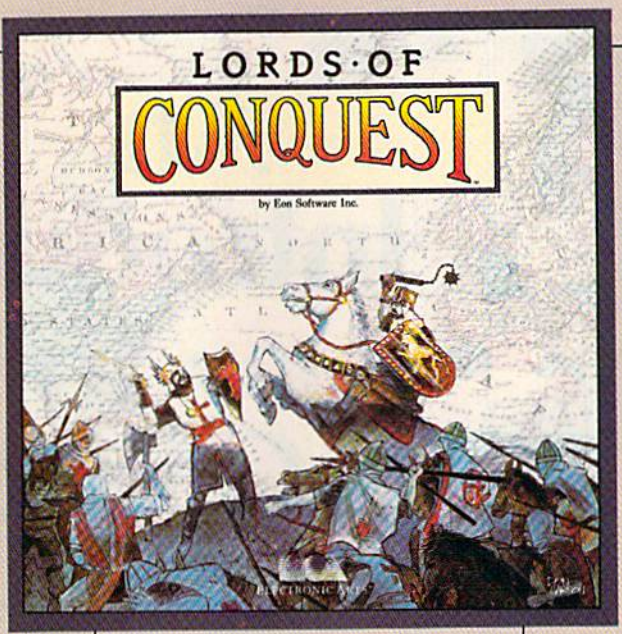

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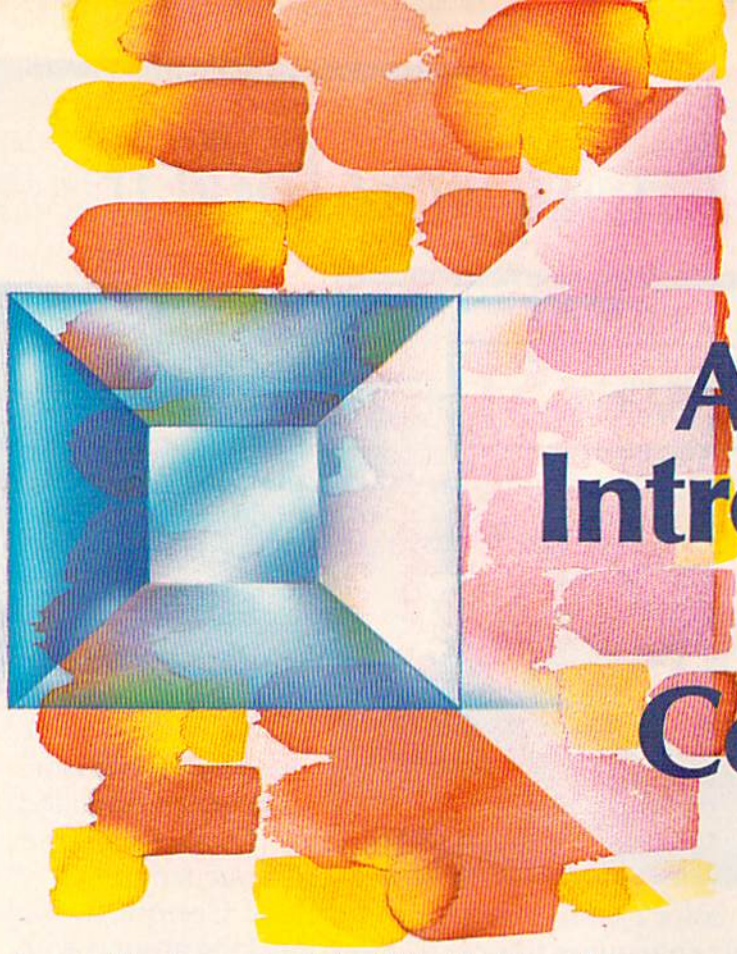


An Introduction To Compilers

Todd Heimarck, Assistant Editor

A compiler is a powerful utility that translates programs written in a high-level programming language, like BASIC, into machine language that your computer can understand without first having to interpret each step. Here's a beginner's guide to one of the most useful items in a programmer's toolkit.

The BASIC programming language has a built-in speed limit that you'll encounter sooner or later. Let's say you've worked hard on writing a large and complex BASIC program. Perhaps it's an arcade-style game, or maybe it's a program to manipulate 1000 customer records for a small- to medium-sized business. The program works; it runs without evident errors. But it's slow—excruciatingly sluggish. You've hit the speed limit.

The fact is, BASIC is not always very good at high-speed screen movement, such as you'd need in an action game. And it's not very fast at sorting large lists, especially if there are lots of strings of data involved. There are many occasions where a program written in BASIC will be excessively slow.

Three Wise Men

Let's say you bring your BASIC program to a local user group meeting and ask the two wisest programmers for their advice. You're looking for techniques to put some more zip into the program.

The first one, an experienced BASIC programmer, says, "I think I see a subroutine that could be rewritten. And this section should be removed and changed to a three-dimensional array. You know, of course, that this bubble sort is not as efficient as a quick sort, although a shell sort might be acceptable. Yes, give me a week or two and I could have it running 20 percent faster. I'll speed it up. Why, my notebook is full of hints and...."

The second one, the best machine language programmer around, interrupts, "Yes, your collection of hints and tricks, I know. But that's just BASIC. I could rewrite it in machine language, using my own algorithms and relative files and perhaps even some sprites and alternate video banks. Hmmm, that would be a nice touch. Of course, it might take a month or so to convert, but it would be worth it."

Then a third person you've never seen before speaks up. "Excuse me; this is my first meeting and I don't know a lot about programming, but I might be able to help. Give me a minute or two."

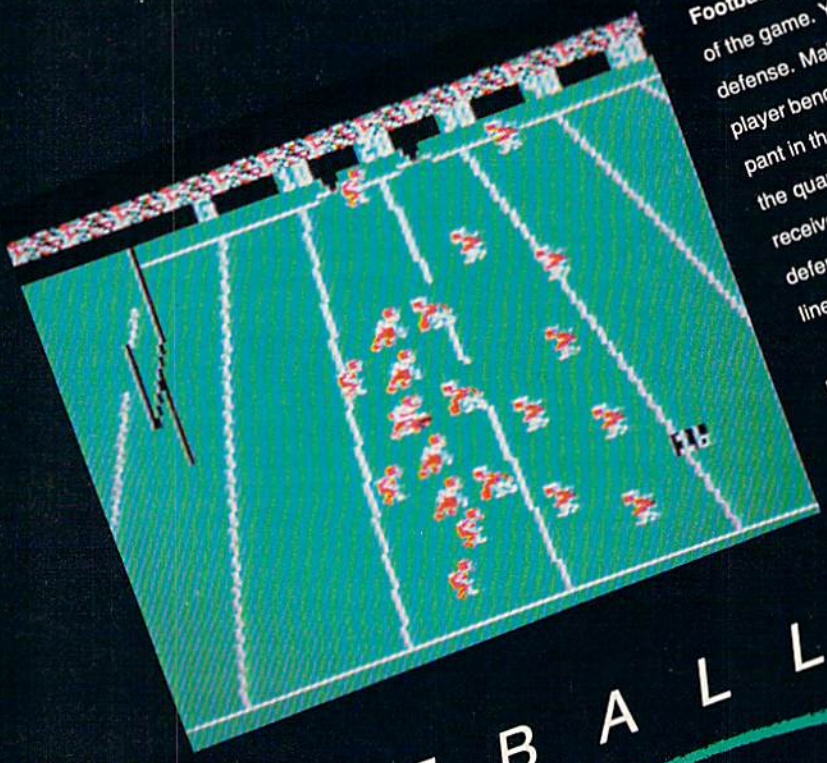
He comes forward with a disk in hand, types a few commands, switches disks, presses a key, and waits for a few minutes. Your original program is changed, almost magically, into a new program that runs about four times faster, and not a single line has been changed. What's happened? Your slow BASIC program has been *compiled.*

The BASICs Of Speed

A BASIC compiler can significantly speed up a BASIC program by converting it into a form that's essentially machine language (ML). To understand how this is possible, we should first take a look at what happens when you run a normal (uncompiled) BASIC program.

Consider the PRINT command. Its purpose seems simple enough—it prints something, usually to the screen—but it can perform a wide variety of actions:

```
PRINT
PRINT "HELLO"
PRINT A
PRINT ABS(A+B)
PRINT "THE NUMBER"; LOG(VAL(A$));
  "IS THE NATURAL LOG OF ";A$
```



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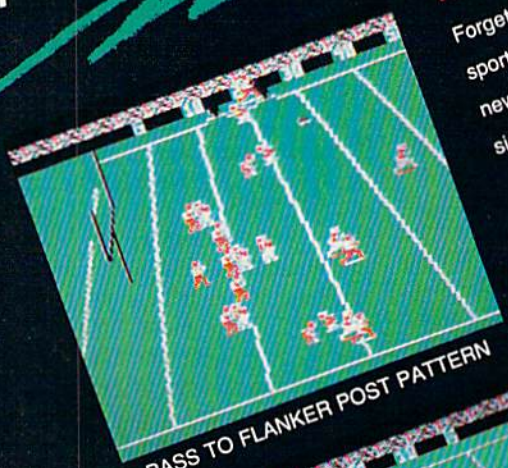

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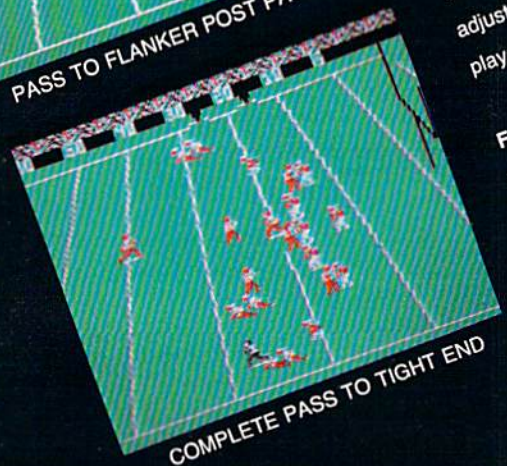

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When a program is running and a PRINT statement comes up, BASIC has to analyze the context. Is it a single PRINT with nothing after it? Is it followed by a string inside quotation marks? Does it refer to a variable? A function? A series of strings, functions, and variables separated by semicolons?

You might think of PRINT as a single command, but it has many flavors. Before your computer executes a PRINT statement, it has to scan forward in the line to decide which sort of PRINT you intend to use. If there are parentheses, the process gets more complicated—the computer has to build up the meaning of the phrase by starting at the innermost parentheses and building outwards.

There's also a second stage, at least when variables are involved. After the computer has figured out that **PRINT AB** means that it's supposed to print the number held in the variable AB, it has to find the variable's location in memory. If 57 variables have been defined before AB is used for the first time, it will be 58th on the list of variables and the PRINT routine will have to search through all 58 variables before AB can be located. When AB is finally found, its value will be printed out.

A Matter Of Interpretation

This process of taking apart a line while the program is running—figuring out what a single command is supposed to do, analyzing the context, looking up variables, and so on—is called *interpreting*. While a BASIC program is running, every command that's executed has to be interpreted first. Interpreting takes time and generally slows down the program.

A compiler speeds things up by interpreting some or all of the commands before the program is run. For example, a compiler might examine a command such as **PRINT AB** and assign a small portion of memory to this variable AB; let's say AB is going to occupy location 5003. The compiler will then store in the compiled program a command that reads something like this: **PRINT (the value at 5003)**.

Instead of having to look up the variable's location when the program is running, which is what the uncompiled program will do, the compiler figures out the address at the time the program is compiled. When the compiled program is run, the computer can go directly to that address instead of spending time looking through memory for a variable.

As another example, consider the line **A = C*34.85**, which multiplies a variable C by 34.85 and assigns the result to the variable A. In a standard BASIC program, the computer will have to find the number in C and then find the floating-point equivalent of the five characters "34.85" (floating-point format is a way of representing numbers that makes it easier to perform mathematical operations). The two numbers will then be multiplied together and the result stored in A.

A compiler has to go through the same steps, but most of them happen at the time the BASIC program is compiled. The compiler figures out the floating-point format of the number 34.85 and decides ahead of time where A and C will be stored. When you run the compiled program, the math is much faster because the computer doesn't have to spend time translating numbers and looking up variables. The compiler has already done much of the work—the interpreting.

One more example: A command such as **GOTO 780** causes several actions to take place. First, the computer translates the three characters "780" to a binary integer (in low-byte/high-byte format), because that's how line numbers are stored in memory. It then compares this number to the current line being executed. If 780 is smaller, the program goes back to the first line of the program and searches through every line number, looking for line 780. If 780 is higher than the current line number, the computer starts searching forward in memory from where the program is. Finally, control is transferred to line 780.

Compare that to how a compiler handles the GOTO. It, too, has to translate the number 780 to an integer. It also has to locate the actual line and the equivalent memory address within the compiled program. Finally, it inserts a machine language jump (JMP) instruction at the appropriate place in the program. But all of the translating and searching happens during compilation, not while the program is running. The result, of course, is a faster program. The compiler does a lot of the work ahead of time so the program can be speedier when the compiled version is run.

A Few Handicaps

As useful as they are, compilers do have some drawbacks and shortcomings.

One problem is that some BASIC compilers support only a subset of BASIC commands. There are some keywords they don't recognize, so you can't use these commands in your programs. (Some compilers do support all BASIC commands, so this is not always a problem.)

Some compilers are extremely fast when programs are limited to integer math (whole numbers), but not when fractions and decimal points are included. In a financial program that uses percentages and dollar amounts rounded to the nearest penny, the time savings afforded by a compiler might not be very significant. Again, this depends on the individual compiler.

Programmers who program interactively generally prefer interpreted languages. They like being able to type a few lines, run the program, change a variable or two, run it again, add a subroutine, use GOTO to test the routine, and so on. With BASIC, you can have the best of both worlds. Use the interpreter to write the program and test it. Then, when it's all done, you can compile it to make it run faster. Some languages are available only in a compiled version, which means a few seconds (or possibly several minutes) of waiting for the source file to be compiled before you can test it. Interactive programmers suggest that this pause stifles their creativity.

One thing that stops programmers from using compilers is the fact that a compiled program is often several times longer than the uncompiled version. An already long program may compile into a version that's too big for memory. Or, if the program fits memory,

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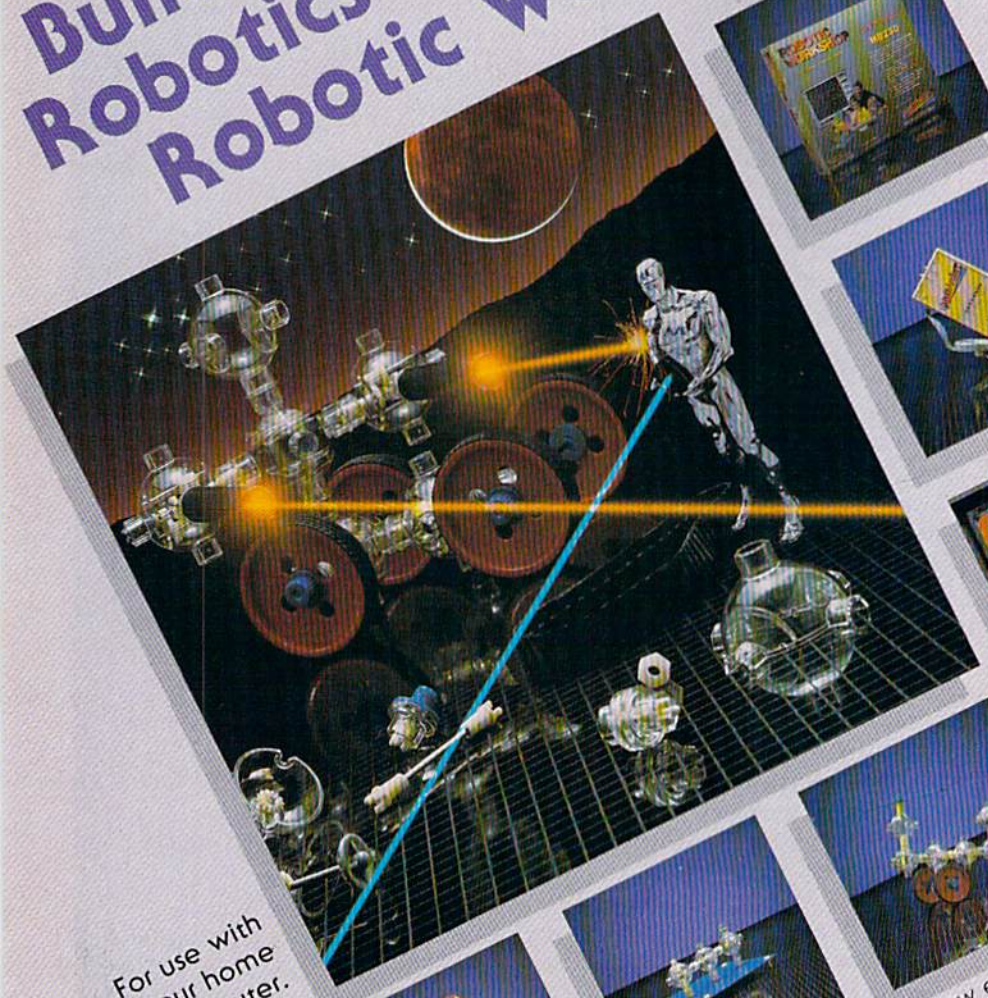

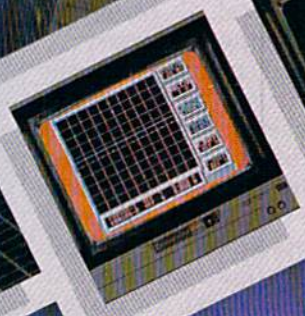

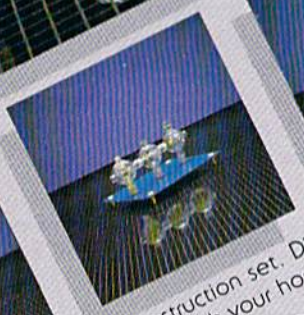

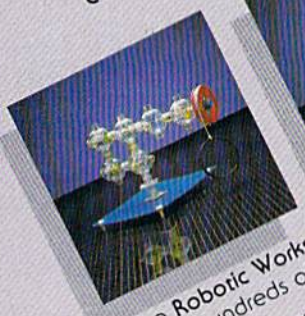

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there may not be enough room left for all the variables.

Some Commodore owners argue that compilers are nice, but if what you want is flat-out speed of execution, nothing beats machine language (ML). A well-written ML program will almost always beat the speed of a compiled program. You don't necessarily have to write a whole program in ML; if the slow part of the program is the alphabetizing routine, you can use an ML sort program to take care of the problem.

Beyond BASIC

So far, we've discussed only compilers that speed up BASIC programs. But compilers are also available for Pascal, C, Forth, and other programming languages.

A compiled language generally requires that you type in the program (also called *source code*) using a word processor or a text editor program. When the source code is finished, you save it to disk and run the compiler program. The compiler then creates the runnable program (the *object code*). To make a change, you must load the word processor or editor again, reload the source code, insert corrections, save, and recompile. It's rare to find a language that includes both an interpreter and a compiler, although both are usually available in Forth.

You should also be aware that there are two types of compilers. The first kind compiles the source code directly into machine language. The second creates a file written in pseudo-code (*p-code*). A p-code program is then combined with a runtime package that includes math routines, printing routines, and all the other features of the language. You may have to load the runtime package as a separate program or use a compiler command to append it to the end of the p-code portion of the program.

We can only begin to scratch the surface here in detailing all of the many features related to different compilers. For more information, contact the following manufacturers about their particular compilers for the Commodore 64 and 128. While this list is not a comprehensive survey of all compilers available, those listed here should help you get started.

ADA Compiler ($39.95)
An ADA programming language compiler for the 64 (Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510).

BASIC Compiler (128 version, $59.95; 64 version, $39.95)
BASIC compiler and development package for the 64 and 128; separate versions (Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510).

Blitz! ($49.95)
A BASIC compiler for the 64 (Skyles Electric Works, 231 E. South Whisman Rd., Mountain View, CA 94041).

C Power ($99.95)
A C compiler that contains both book and disk (Pro-Line Software, 755 The Queensway East, Unit 8, Mississauga, Ontario, Canada L4Y 4C5).

COBOL Compiler ($39.95)
A 64 COBOL programming language compiler and development package (Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510).

C-64 Forth/79 ($69.95)
A Forth programming language package for the 64 (Performance Micro Products, P.O. Box 370, Canton, MA 02120).

Forth-64 Language ($39.95)
A Forth programming language compiler and development package for the 64 (Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510).

Gnome Speed ($59.95)
A 128 BASIC compiler (SM Software, P.O. Box 27, Mertztown, PA 19539-0027).

KMMM Pascal ($99)
A Pascal programming language compiler and development package for the 64, recently updated (Wilserve Industries, P.O. Box 456, Bellmawr, NJ 08031).

Kyan Pascal ($49.95)
A Pascal programming language compiler for the 64 (Kyan Software, Suite 183, 1850 Union St., San Francisco, CA 94123).

MasterForth ($100)
A Forth programming language compiler and development package, including a graphics system (MicroMotion, 8726 S. Sepulveda Bl., #A171, Los Angeles, CA 90045).

PROMAL (end-user version, $49.95; developer version, $99.95)
A 64 PROMAL programming language development package (SMA, 3700 Computer Dr., P.O. Box 20025, Raleigh, NC 27619).

The Sixty Forth ($39.95)
A Forth programming language compiler for the 64 (Elcomp Publishing, 2174 West Foothill Blvd., Unit E, Upland, CA 91786).

Super C Language Compiler (128 and 64 versions, $59.95 each)
A C compiler on disk in both 64 and 128 versions (Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510).

Superforth 64 ($59.95)
A Forth programming language compiler and development package for the 64 (Parsec Research, Drawer 1766, Fremont, CA 94538).

Superforth 64+ Artificial Intelligence ($99)
A Forth programming language compiler and development package, plus an expert system development module (Parsec Research, Drawer 1766, Fremont, CA 94538).

Super Pascal (128 version, $59.95; 64 version, $39.95)
A Pascal programming language compiler and development package for the 64 and 128; separate versions (Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510).

White Lightning ($49.95)
A 64 compiler and development kit for the Forth programming language (Oasis Software, 377 Oyster Point Blvd., Unit 15, San Francisco, CA 94080).

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BASIC for beginners

The PRINT Statement

Larry Cotton

As promised, we're going to look at more uses for PRINT, one of the most versatile BASIC statements. The best way to get familiar with PRINT is to write simple programs which feature it, which we'll do this month.

But first, you need to know how to save a BASIC program on a disk. The procedure is as follows:

1. The disk must be compatible with Commodore computers. Almost all are. If you have any doubts, buy your disks from a dealer who knows what he's selling.

2. A new disk must be set up (formatted) to receive information (files). To format a disk, put a new disk (or one that contains expendable files) in the drive and close the door. For the Commodore 64 or VIC, type

```
OPEN 15,8,15:PRINT#15,"N0:MISC,
  GZ":CLOSE 15
```

and press RETURN. That statement will also work on the Plus/4, 16, and 128, but those computers also have a simpler statement that performs the same function. Type

```
HEADER "MISC",D0,IGZ
```

and press RETURN.

After a couple of minutes the drive will stop running and the busy light will go out. The disk is now formatted and ready to receive information. You can substitute any name for the word MISC as long as it's not over 16 characters long. In the VIC/64 command, follow your disk's name with a comma and two characters for the disk ID. The example statement above uses the letters GZ for the disk ID, but you can use any two characters you like. Just be sure to give each disk a unique ID. For the HEADER command, the ID is specified in the two characters following the ,I at the end of the command.

3. Make sure there is enough room on the disk for your program. (One program we'll write takes about two *blocks*—a measure of disk capacity). To check the contents (directory) of the disk on the VIC or 64, type

```
LOAD "$",8
```

and press RETURN. That command also works on the Plus/4, 16, and 128, but those computers have a simple command to perform the same function. Type

```
DIRECTORY
```

and press RETURN. (The 128 also has a CATALOG command, which functions exactly the same as DIRECTORY.)

4. To save a program on the formatted disk (the program, of course, must be in the computer's memory), type

```
SAVE "PRINT EXAMPLES",8
```

and press RETURN. As with the other statements, the Plus/4, 16, and 128 have a simpler form. Type

```
DSAVE "PRINT EXAMPLES"
```

and press RETURN.

The drive will run, the busy light will come on, and your program will be saved on the disk. Substitute anything you want, up to 16 characters long, for the filename PRINT EXAMPLES. Once the drive stops, you can turn the computer off, which erases your program. By the way, it's not a good idea to cram a disk full. The more programs you have on a disk, the more you stand to lose if the disk is accidentally damaged or erased.

5. If you really like a program, save it on two disks.

The Versatile PRINT Statement

The *Commodore 64 Programmer's Reference Guide* says there is "no statement in BASIC with more variety than the PRINT statement...it might almost be considered as a language of its own...."

You already know that PRINT sends information directly to the TV or monitor screen. You can put words, numbers, and symbols anywhere on the screen using only PRINT. It may be used in either the *immediate mode* (as a command you just type on screen and follow by pressing RETURN) or *program mode* (as a statement within a program).

Be sure to remember that any time you type something in immediate mode, you must press the RETURN key when you're finished with the command, or when you want to see the results.

And when you're typing in, or changing, BASIC program lines (they always have numbers in front of them), be sure to press RETURN to store each line in the computer's memory. I'm not always going to note that you should press RETURN, except in unusual circumstances.

(Many non-Commodore computers call the RETURN key the ENTER key. The Commodore 128 computer has an ENTER key with its new numeric keypad. It serves the same purpose as RETURN.)

Printing Variables

Start by typing this: X = 4. You should press the RETURN key right after that. This causes the computer to "remember" what X is until you change it or reset the computer's memory. X is known as a *variable*, because its value can vary.

When you assign a letter a value, you can see what its value is by typing PRINT *x*, where *x* is the letter representing the variable. (Incidentally, you can abbreviate PRINT with a question mark.) For instance, type: ? X. You should see 4 (assuming you typed X = 4 above). Now add something to X—say 5, like this: PRINT X + 5. You should see 9. You can also assign another vari-

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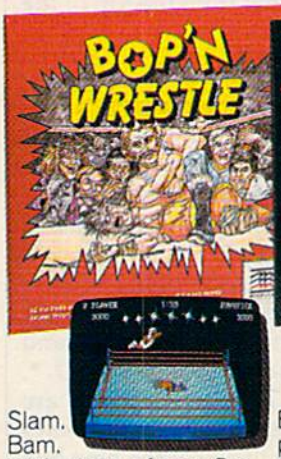

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able, such as Y, for the 5. Type Y = 5; then type PRINT X + Y. (Think of the implications for doing math on your computer. Later, we'll devote a column or two to BASIC math functions.)

You can also make words variables. How does the computer distinguish between numbers and words? Use a $ sign after the variable letter to make it a word. For instance, type A$ = "PIECE " (note the space between the E and the quotation marks); then type PRINT A$. You should see the word PIECE printed out.

Believe it or not, BASIC allows words to be *added together.* How? Type PRINT A$ + "OF CAKE" (always remembering to press RETURN). You should see PIECE OF CAKE printed to the screen.

As with numbers, you can use another variable—say, B$—for "OF CAKE": Type B$="OF CAKE", and then type PRINT A$ + B$. Voilà. These word variables ($) are called *strings.* A$ is called A-string, B$ is called B-string, and so on. There are probably as many applications for manipulating strings as there are for arithmetically manipulating numbers.

Printing Symbols

Temporarily, we'll leave printing numbers and words, and go to the symbols that are on the front side of the computer's keys. These are called graphics characters, and are unique to Commodore. They have many uses.

You can print these symbols to the screen by holding the SHIFT or the Commodore key while typing any key with a graphics character on it. The best way to learn to use symbols is to experiment. Because of the variety of symbols, it's possible to create pictures, graphs, and charts, and to enhance the appearance of a printed screen by using the symbols to form borders and boxes.

Moving The Cursor

The cursor's position—the spot where things are printed on the screen—can also be controlled with the PRINT statement. Commodore uses a somewhat arcane method of indicating which way the cursor will move; a short BASIC program and practice are the best teachers here. (Remember, you can use a ? instead of typing PRINT. When you LIST the program, the word PRINT will be displayed.) {DOWN} means you should press the cursor-down key, located next to the right SHIFT key.

```
10 PRINT"FIRST"
20 PRINT"SECOND {DOWN}"
30 PRINT"THIRD"
40 PRINT"{DOWN}"
50 PRINT"FOURTH"
```

Run the program and study the results. Line 10 prints the first word, then moves the cursor to print the next item on the line immediately below. In line 20, however, there is a cursor-down character before the second quotation mark, which makes the cursor skip a blank line between the second and third words.

Line 40 contains a cursor down on its own separate line, which yields two blank lines between the third and fourth words.

Also try experimenting with cursor-right, -left, and -up characters. If you'd like to save your experiments on disk, do so now. Then reset the computer by turning it off, then on.

Other PRINT-ables

There are several other miscellaneous, but very convenient, uses for the PRINT statement:

1. Moving the cursor to the top left corner of the screen.
2. Moving the cursor to the top left corner of the screen and clearing the screen at the same time.
3. Changing text colors.
4. Printing characters in reverse video.
5. Printing blank lines.

A Demonstration

We'll type in another short BASIC program, line by line, which illustrates all the discussed uses for the PRINT statement. It will print two messages inside a small border.

The example program contains a number of underlined characters and words in braces ({ }). These are the GAZETTE's way of representing characters which require special typing. You'll need to understand these *listing conventions* to type in any programs in the magazine. For example, when you see an underlined character, you should hold down the SHIFT key while typing that character. For a detailed description of the conventions, refer to the article "How to Type In COMPUTE!'s GAZETTE Programs" elsewhere in this issue.

Let's begin the program with a line that turns the screen black—both background and border. To do this, we must use BASIC statements we haven't covered yet—POKE on the 64 and COLOR for the Plus/4, 16, and 128. We'll look at these in a future column, but for now, just type line 10 as you see it.

For the Commodore 64:

```
10 POKE 53280,0:POKE 53281,0
```

For the Plus/4, 16, or 128:

```
10 COLOR 0,1:COLOR 4,1
```

Now let's clear the screen (which also moves the cursor to the upper left corner of the screen—called the *home* position):

```
20 PRINT"{CLR}"
```

The cursor needs to be moved down somewhat from the top of the screen:

```
30 PRINT"{6 DOWN}"
```

(If you examine the GAZETTE's listing conventions, you'll notice that the {6 DOWN} means to press the cursor down key six times.)

The next line prints the top of a horizontally centered border. It's composed of cursor-right, SHIFT-U, SHIFT-*, and SHIFT-I characters. Notice the rounded corner and horizontal line symbols on the U, *, and I keys. The cursor-rights are necessary because the cursor always starts at the left edge of the next line down after a PRINT statement.

```
40 PRINT"{9 RIGHT}U{17 *}I"
```

(Again, you'll need to understand the GAZETTE's listing conventions to enter this line properly. For example, the {17 *} means to hold down the SHIFT key and type the * key 17 times.)

To PRINT the sides of the border, we'll use the same program line, repeated seven times. There are other ways to do this, but let's save them for another time. Type in the line 50 shown below and press RETURN. Then move the cursor back up over the 5 in the line number and type a 6 to make 60; then press RETURN again. LIST the program. You'll see both lines 50 and 60, and they will be identical. Do the same for lines 70–110. This is

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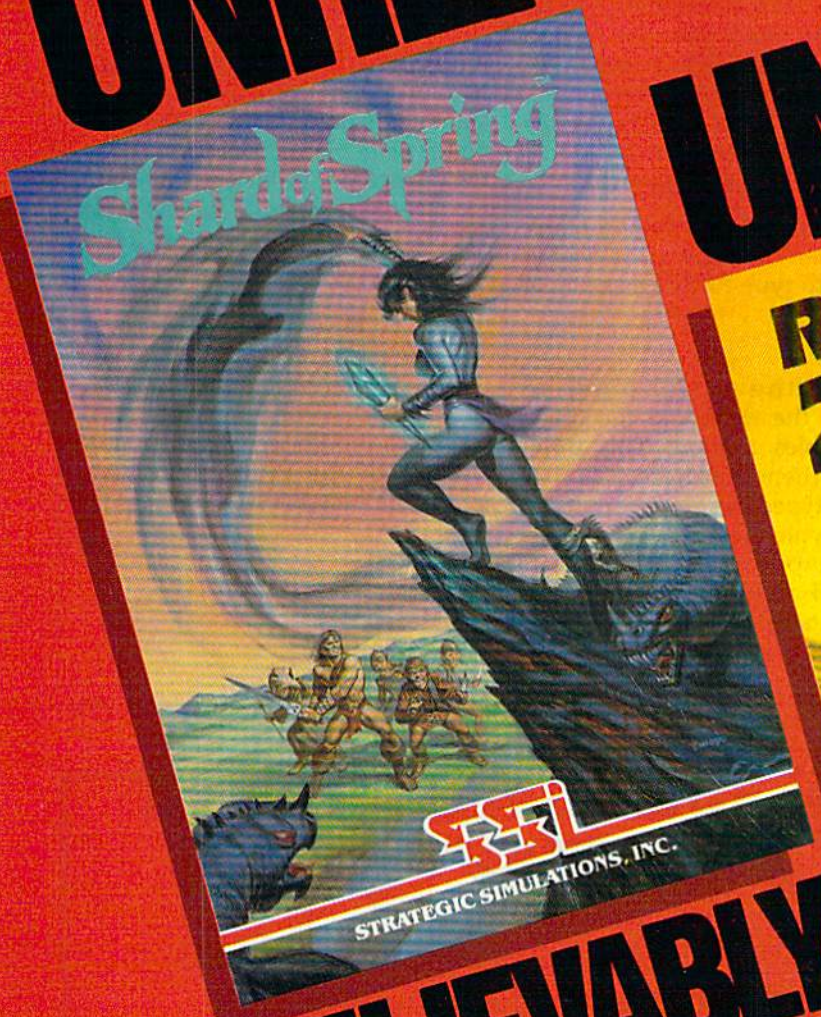

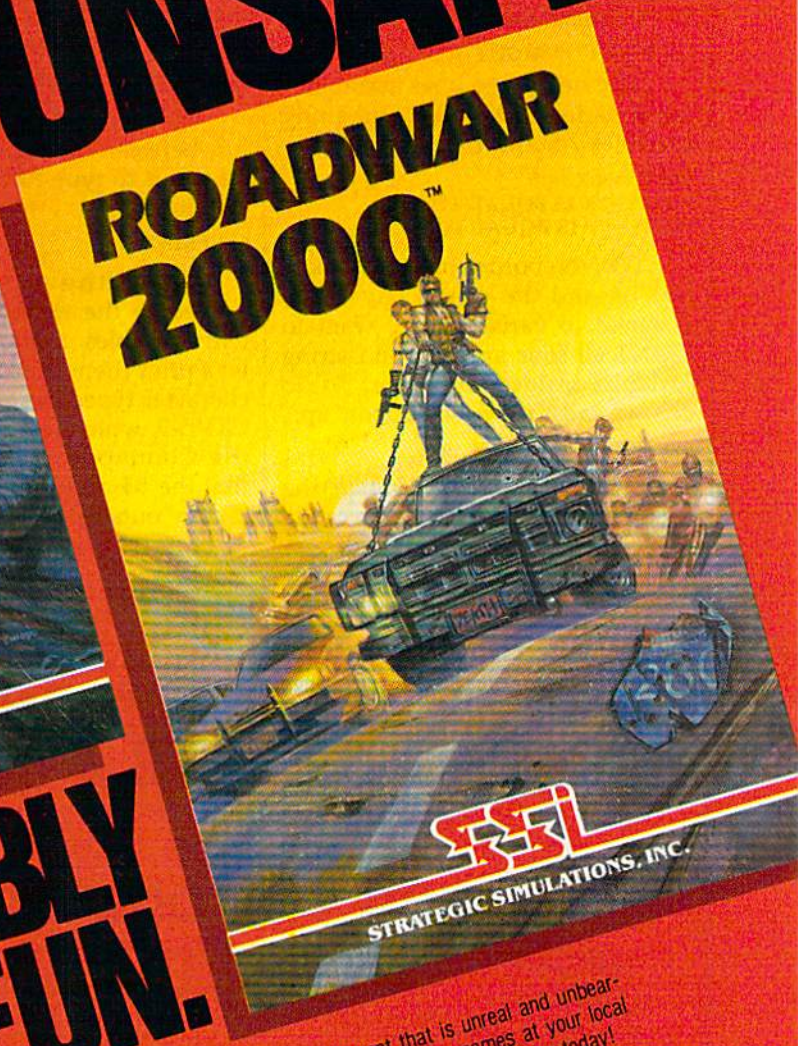

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what makes BASIC programming so easy on Commodore computers.

```
50 PRINT"{9 RIGHT}B{17 SPACES}B"
```

The bottom of the border is almost like the top, so let's make a virtual copy of line 40. Just move the cursor to line 40 and type 120 over the 40, change the SHIFT-U to SHIFT-J and the SHIFT-I to SHIFT-K, and press RETURN.

```
120 PRINT"{9 RIGHT}J{17 *}K"
```

The next three lines assign numeric variables X and Y and string variables A$ and B$:

```
130 X = 4:Y = 5
140 A$="X IS EQUAL TO"
150 B$="Y IS EQUAL TO"
```

OK, the border has been taken care of, and the values have been assigned to variables. We want to PRINT all four numeric and string variables inside the border. To do this we must move the cursor up:

```
160 PRINT"{7 UP}"
```

The next line will move the cursor over from the left edge of the screen and print the first message. The first character typed after the opening quotation mark is CTRL-8, which changes the text color to yellow.

Note that the variables A$ and X are typed right after the second quotation mark. This insures that what you want to print stays on the same line with the cursor after it's been moved to the right.

```
170 PRINT"{YEL}{11 RIGHT}"A$;X
```

Now we want to print a blank line between messages. One way to do this is to type PRINT as a single statement.

```
180 PRINT
```

Next, the cursor must be moved to the right and the other two variables printed. This time, let's print them in reverse. The first character typed inside the quotes is CTRL-9, which reverses the text on the Commodore 64. Note again that the B$ and Y are typed immediately outside the quotes.

```
190 PRINT"{RVS}{11 RIGHT}"B$;Y
```

Last, let's send the cursor back to the upper left corner of the screen—the home position.

```
200 PRINT"{HOME}"
```

What do the colons in lines 10 and 130 do? Their main purpose is to allow you to combine two BASIC statements on one line. If the statements were placed in separate lines, the program would run the same. Colons often separate BASIC statements which are similar. They make the program more compact, and, when used judiciously, easier for others to understand.

Have you run the program yet? If not, do so, and don't forget to save it on disk for future reference.

Next month we'll look at more features of the PRINT statement, and some new BASIC commands.

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BUMP-N-RUN

Tim J. Midkiff, Editorial Programmer

Challenge a friend in this fast-paced, action-strategy game for the Commodore 64. It's written entirely in machine language for rapid play and smooth movement. Two joysticks are required.

This two-player action game can be played at two conceptual levels: When you first play, it seems to be purely an action game—all speed and reflexes—but after you and your opponent master the basics of the game, you'll discover the importance of having a strategy.

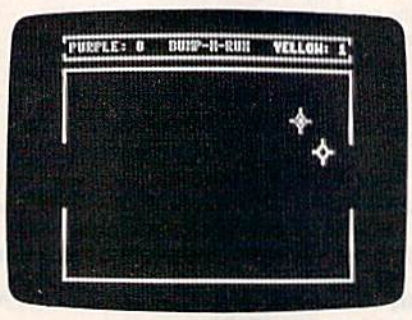
The object of "Bump-N-Run" is to get the ball and shoot it into the other player's goal. Of course, your opponent is trying to do the same, and this is the conflict which is the heart of the game.

Typing It In

Bump-N-Run is a machine language game, so you must use "MLX," the machine language entry program found elsewhere in this issue, to type it in. Be sure you understand how to use MLX before you begin entering the data for Bump-N-Run. After loading and running MLX, respond to the prompts with the following:

Starting address: C000
Ending address: C6A7

Save a copy to disk or tape when you've finished typing. To load the game, type LOAD"BUMP-N-RUN",8,1 (tape users should type LOAD "BUMP-N-RUN",1,1) and SYS 49152 to begin play. Be sure to have two joysticks plugged in. Press RESTORE to exit the game, and SYS 49152 to replay.



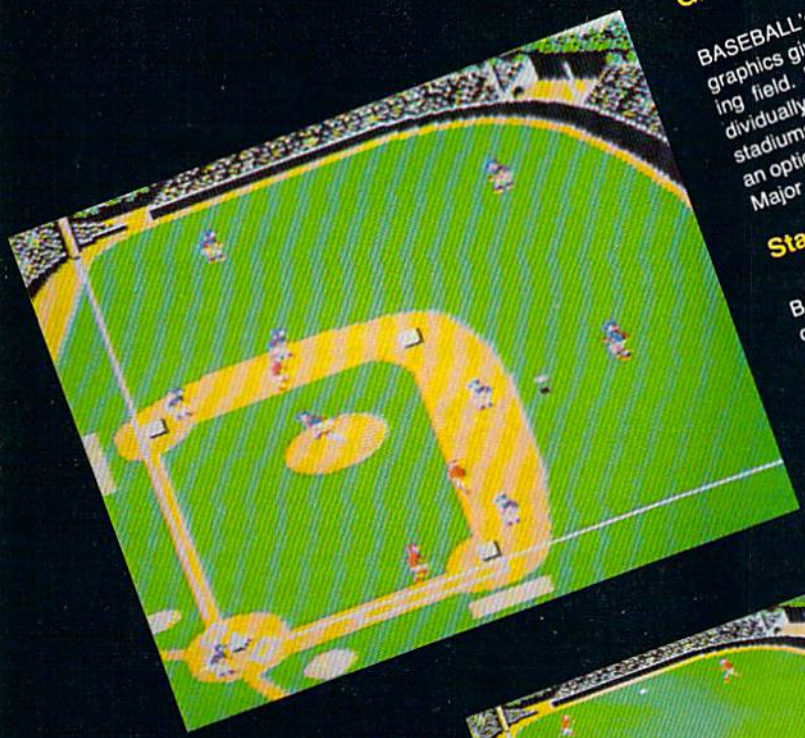
One player has the ball and is threatening to score. The other is going to try to steal the ball by bumping his opponent.

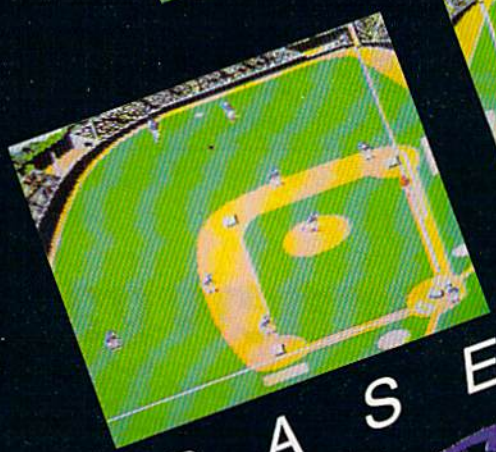
Bumping And Running

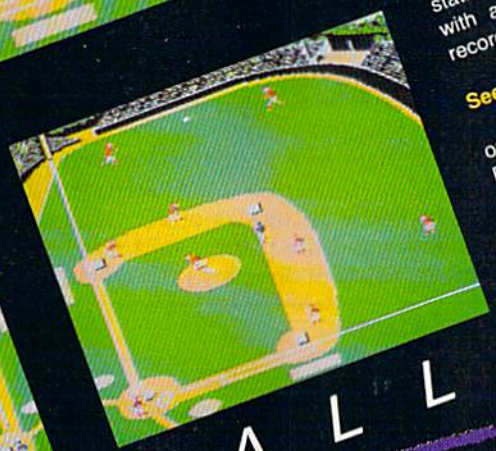
As with many computer games, the best way to learn this one is by playing it. The game begins with the ball in the middle of the court and each player guarding his own goal. The joystick in port 1 controls the purple player. The yellow player is controlled by the joystick in port 2. Catch the ball by touching it with your player. Your opponent can then steal the ball by bumping into you. The direction and speed your player travels is controlled by the joystick. When you first push the joystick, you move slowly; keep pushing and you'll accelerate. Press the fire button to shoot the ball. When the ball is released, you lose your speed, but the ball continues on with your previous speed and direction. Make sure your shot is accurate, because once you shoot the ball you can't catch it again until it bounces off a wall. Remember that you can steal the ball from your opponent at any time simply by bumping him. The first player to score 15 goals wins, and the game is reset when both players press the fire button.

Here are a few more details concerning the physics of the game. When players collide, their velocities and directions are exchanged. Collisions with the walls cause players to bounce back. A player may go beyond the walls only if he is pushed by another player.

See program listing on page 112.







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Graphics

BASEBALL's highly-detailed animated graphics give you a perfect view of the playing field. Each player acts and moves individually on every play. Three different stadiums are included with the program, and an optional Stadium Disk lets you play in any Major League stadium in the United States.

Statistics

BASEBALL can maintain a complete statistical record of each team player's performance. All player stats and game Box Scores can be displayed on the screen or sent to an external printer for a hardcopy printout.

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Obstacle 128

Stephen Cheng

Here's an example of how to tap the power of BASIC 7.0. It's a short program and uses no machine language—yet the result is a fine, fast, two-player, hi-res action game. For the Commodore 128.

"Obstacle 128" is a short two-player arcade-style game for the 128. At a length of roughly 1K, it's a much more condensed program than a similar version for the 64 would be.

The game concept is not new. It's basically a version of the classic *Tron* game where two light-cycles duel to see who survives. Four choices face you as your light-cycle tools around the playing area: Do you move up, down, left, or right? If you make no choice, you continue in the direction in which you were already moving.

Trailing behind each player is a wall of light, which both must avoid hitting. Eventually one player or the other gets trapped in an ever-shrinking area and crashes into a wall. The survivor wins one point.

After typing Obstacle 128 in, save a copy. To play, load it and type RUN. Be sure to have two joysticks plugged in. The first player to accumulate five points is declared the winner. There is some variety in every battle as the size of the arena changes and the players start moving in different directions. There are several strategies to this game, but in general the player who carves out the most area and commits the fewest mistakes will be the winner.

How It Works

The program is divided into three parts: the setup of the screen in lines 10–40, joystick control and graphics in lines 50–200, and sound effects and scoring in lines 210–320. Let's look at the program in some detail.

In line 10, GRAPHIC 3,1 turns on the multicolor graphics mode and clears the screen. SOUND 3,100,30000 generates an incessant beat of a low frequency (100 cycles per second) for 30000 jiffies, so this will last 8 minutes and 20 seconds, enough for the whole game.

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Infocom,™ the crazy people who brought you "Zork"® and "The Hitchhiker's Guide to the Galaxy,"™ has a habit of coming up with games that add a new dimension to interactive fiction. And the best keeps getting better. Case in point: "Leather Goddesses of Phobos."™ It has a scratch n' sniff card and a 3-d comic book to excite all your senses. Once your interest is piqued, you'll embark on a rowdy romp through the solar system. This hilarious spoof of 1930's pulp science fiction has 3 "naughtiness levels," for the prude to the lewd. "Leather Goddesses" is sure to amuse members of either sex.

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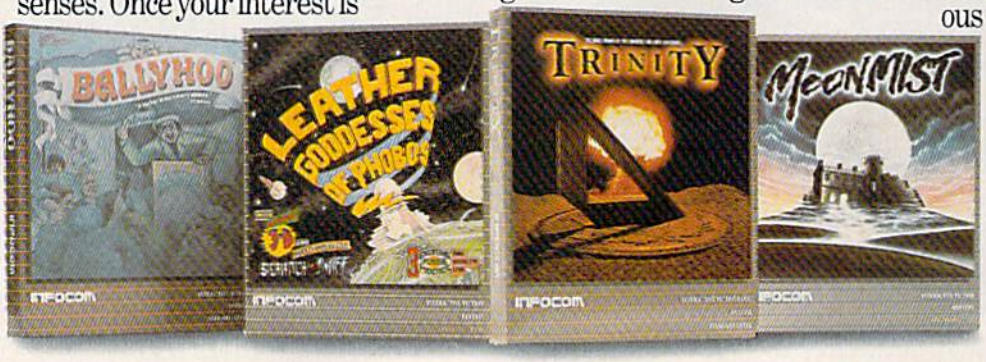

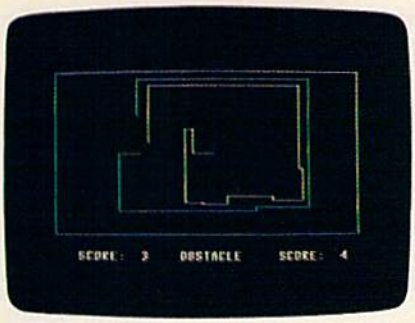

Note how both players have closely followed each other in an attempt to cut each other off. Current positions are in the upper left section of the screen.

Line 20 sets the background color, the border color, and multicolor 1 and 2. A random number between 30 and 69 determines the size of the playing field. The handy CHAR command places text anywhere on the screen. The +S and −S in the DRAW commands are used to shrink the *y*-axis (the height) of the arena.

Line 40 generates the locations and the starting positions of the combatants in the arena. X and Y are the *x* and *y* coordinates for the position of the first player, and A and B are the coordinates of the second player. In line 40, X is subject to a little randomness, as is A, so that the players start at different *x* coordinates when the game begins. Y and B are set at 100, so both players will start in the middle of the screen.

Next, random values are assigned to J and K, the directions of movement of player 1. If J is 1, the player travels to the right, and if J is −1, the player travels to the left. If K is 1, the player moves down, and if K is −1, the player moves up. Since this game has no diagonal movements, one of the two directions has to be zero, while the other is nonzero. L and M are the corresponding movement directions for player 2. Notice that L=J and M=K, so both players will start traveling in the same direction at the beginning of the game.

The Main Loop

After the board is set up, we're ready to start the game. Lines 50–200 are the main loop, where all the action takes place. The joystick reading function (JOY) is quite handy. In line 50, J1=JOY(1) assigns a number to variable J1 depending on where joystick one is pointing. If the joystick is untouched (centered), J1 equals zero and the program skips the next four lines.

Lines 60–90 control the direction of movement of player one, adjusting the *x* and *y* coordinates based on the current state of the joystick.

Line 100 sees if the cyclist bumps into anything such as his trail, the other player, or the arena walls. LOCATE X+J,Y+K moves the pixel cursor to the new position, which is calculated by adding the direction of movement to the player's current position. Then we read the dot color of the selected pixel, using RDOT(2). If the color is either 2 or 3, player one has crashed into something and lost a battle. Thus, in line 100, if RDOT(2) > 1 THEN J3=1. J3 is a flag which signals whether the player has crashed or not. Line 110 updates the position of player one, and the DRAW command puts a small dot with color 3 on the screen representing the player.

Lines 120–180 are the analogous lines for player two. The only thing different is that new variables

es. One really smells.

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and save your hide from a permanent spot in the freak show, you'll need to stretch your puzzle-solving skills to the limit.

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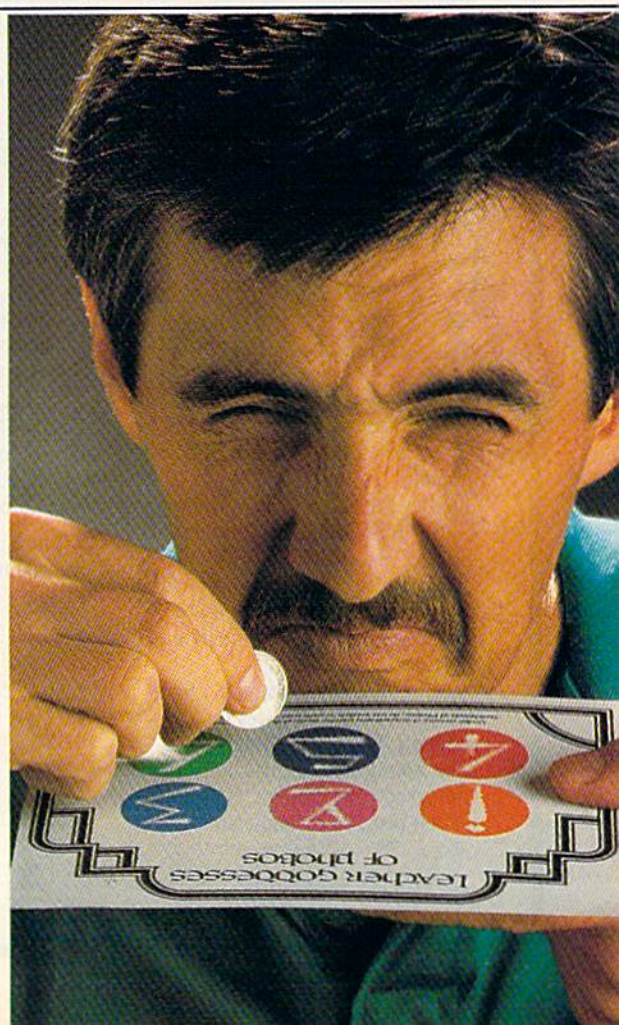

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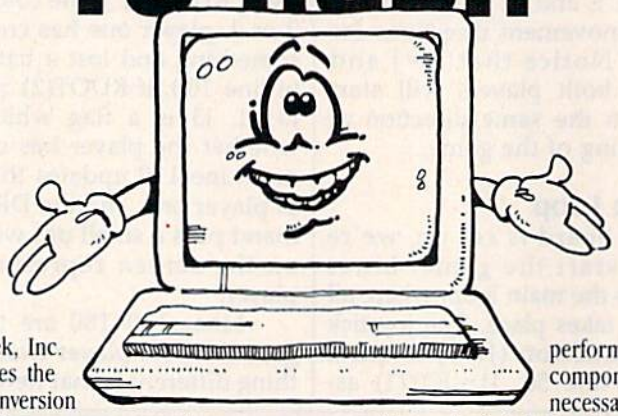

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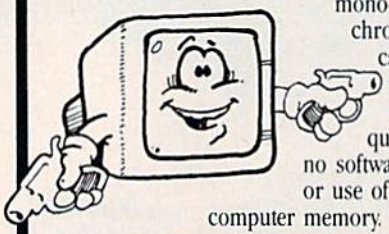

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are needed to store the data for player two.

Line 190 tests whether either player has crashed. If so, the program jumps to the scoring section in lines 210–310. Line 200 directs the program back to the start of the joystick-reading part beginning at line 50 to continue with the movement of both players.

The final part of the program contains the routines for scoring, sound effects, and printing crash messages on the screen. Line 210 makes an explosion sound and prints the CRASHED message for player 2. Lines 220–230 detect the rare occurrence when both players crash at the same time. Line 240 prints the CRASHED message for player 1. Line 260 creates another explosion, and the computer SLEEPs for one second so that the players can view the screen for a short time. The two scores are converted to strings, because CHAR can't handle numeric variables, and printed to the hi-res screen. Lines 280–290 check whether either player has won five matches. If so, a congratulatory message is displayed for the winner, and the program jumps to line 310. Otherwise J3 and J4 (the collision flags) are reset to zero and another round begins.

There are several ways programmers could modify and enhance the game. When a player crashes into a wall, perhaps you could use CIRCLE to draw a series of concentric circles to mark the spot where the crash happened. Then flash the hi-res screen by alternating background colors (COLOR 0) a few times. You might also want to experiment with the sound effects and the victory song at the end of the game. To make the game more challenging, use CIRCLE or BOX to put some barriers on the screen. The players would face the additional challenge of avoiding the obstacles.

It wouldn't be especially difficult to convert Obstacle 128 to a one-player game—you against the computer. A simple technique for moving the computer player is to use RDOT to check for an imminent collision, then pick a right or left turn. A slightly more intelligent routine would look ahead, to see which direction has more empty space.

See program listing on page 116.

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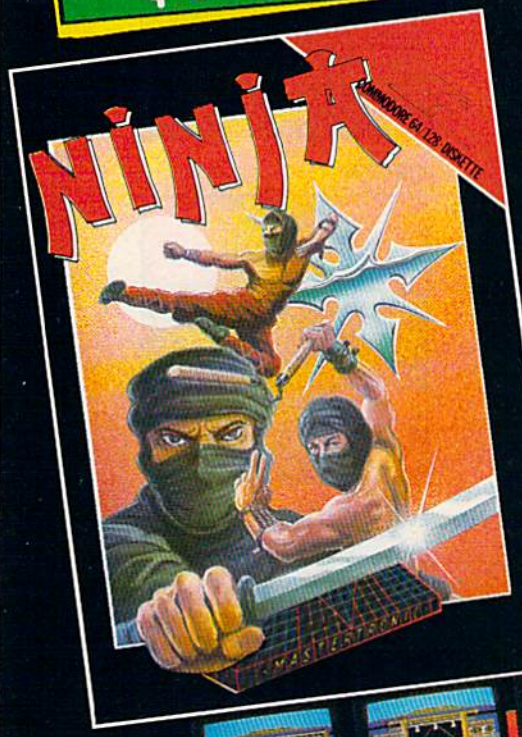

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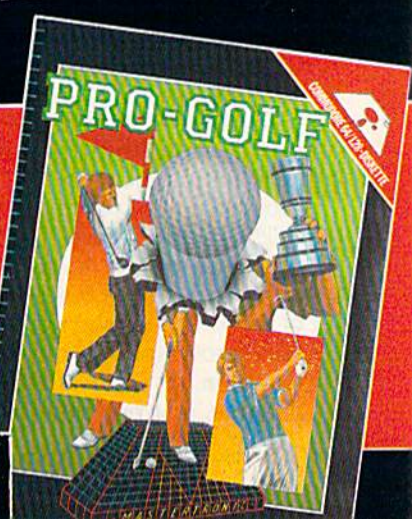


Match Blox

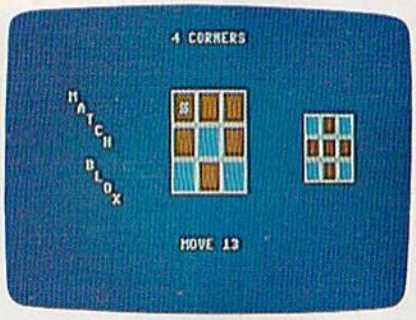
Mark Tuttle

If you like puzzles, try your hand at one of the five variations of this entertaining solitaire game for the 64, Plus/4, and 16. A joystick is required.

"Match Blox" is a solitaire puzzle game in which you try to solve any of the five variations in the fewest number of moves possible. Each game is played on a 3 × 3 matrix of squares, and each square is colored blue or orange. The object is simple: Manipulate the squares until they match the pattern displayed.

The program listing (Program 1) for Match Blox is for the Commodore 64. If you have a Plus/4 or 16, type in Program 1, but substitute the lines from Program 2 for the corresponding lines in the Program 1 listing.

After you type in the program, save a copy. To use it, plug a joystick into port 2 (port 1 on the Plus/4 or 16), load it, and type RUN. The program first displays the titles of the game variations, numbered 1–5. A box at the bottom of the screen displays the number 1, which corresponds to the first game variation. (If you want to start with this one, just press the fire button.)

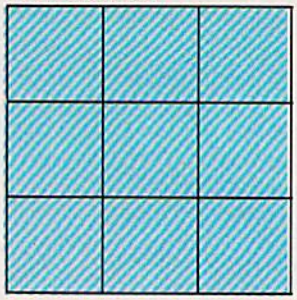


You must think ahead for success in this solitaire strategy game for the Commodore 64.

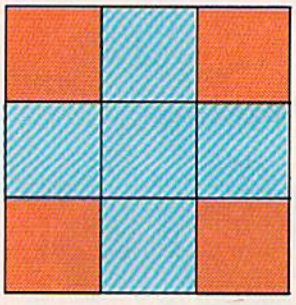
To select any of the five games, move the joystick left or right. Right increments the variation number (it will roll over from 5 to 1), and left decrements the number (it will roll over from 1 to 5). Press the fire button when the number displayed corresponds to the game you wish to play.

The patterns to be matched for each of the game variations are as follows:

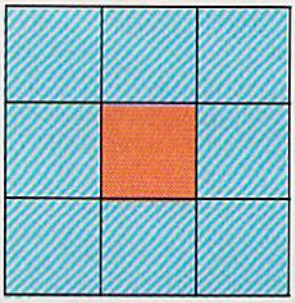
UNI-COLOR



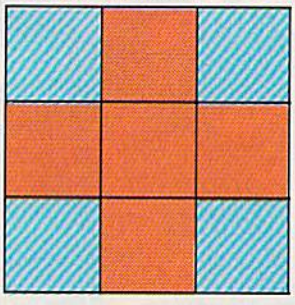
CROSS



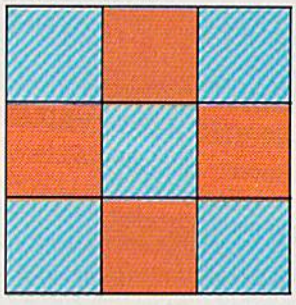
NO CENTER



FOUR CORNERS



FIVE POINTS



Matching The Pattern

After you choose a game, the screen displays the game board in the cen-

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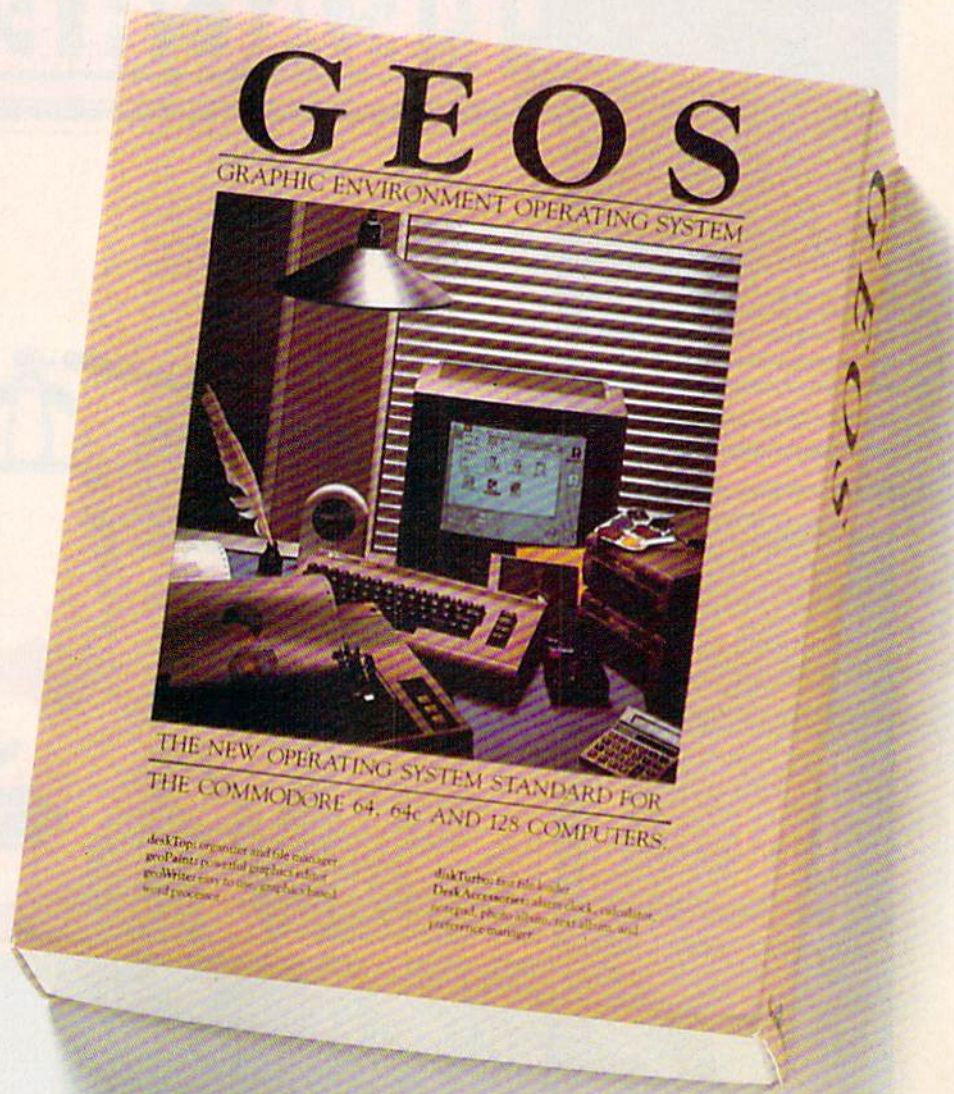
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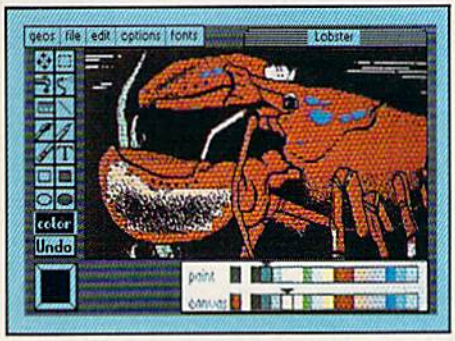

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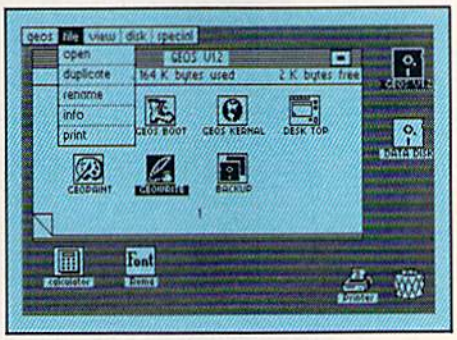

thing about a new universe is finding your way around. But with GEOS, you only need to remember two things:

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Running out of space. With GEOS, that's hardly likely. Because there's endless space in the universe for new applications.

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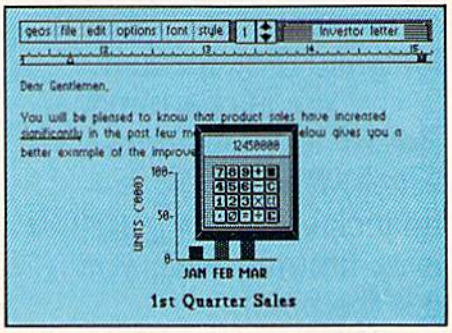

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Bubble	Telegraph
Durant	Mykonos
Harmon	**Superb**
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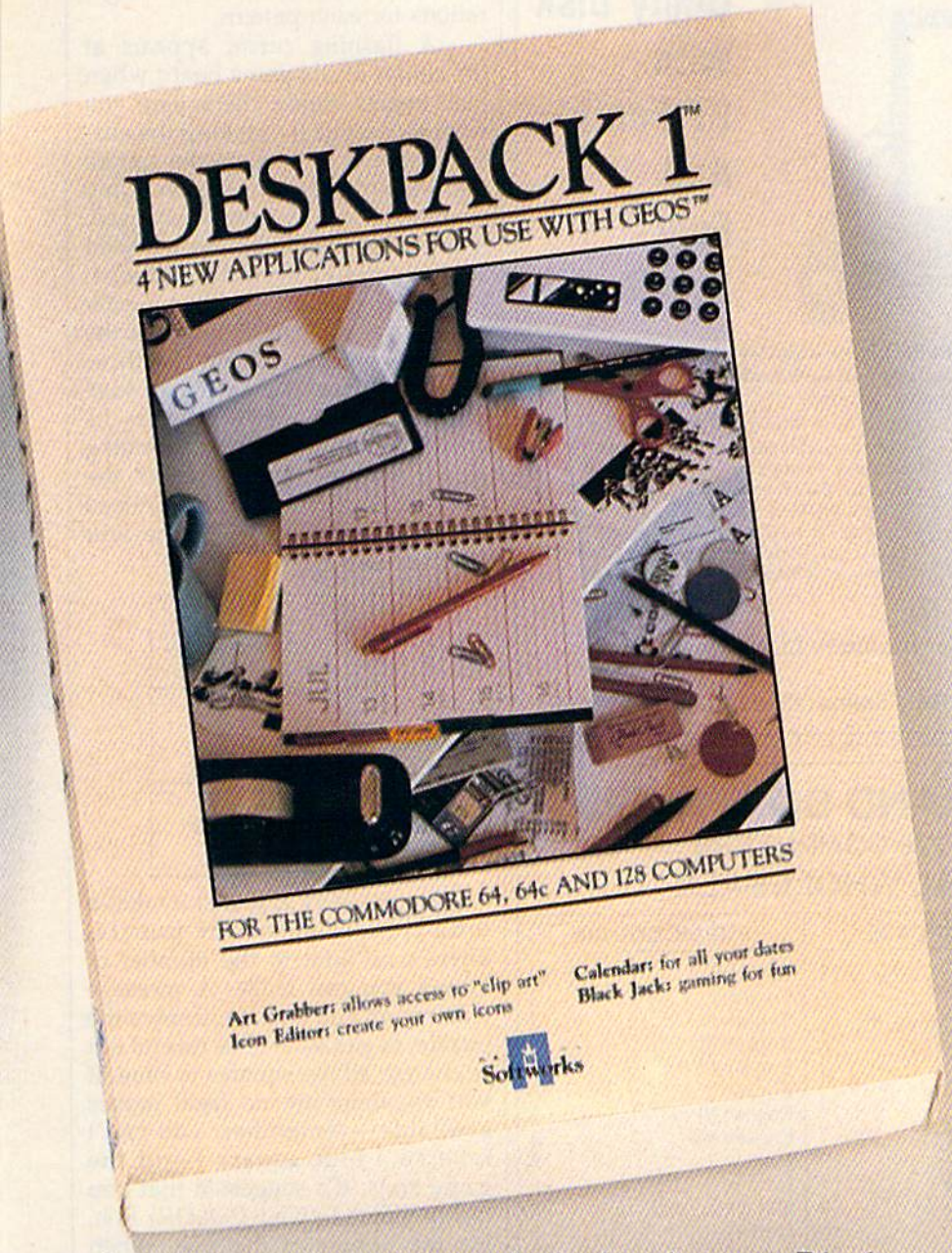
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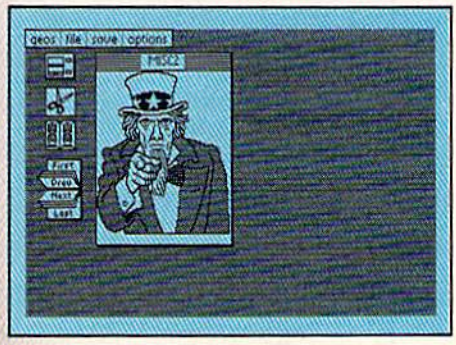

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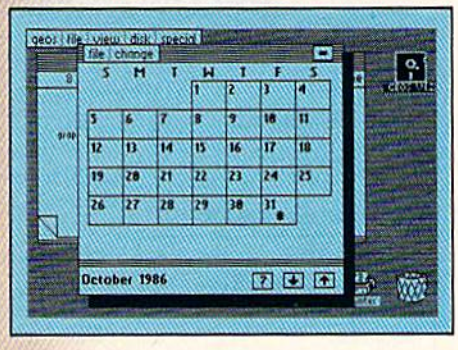

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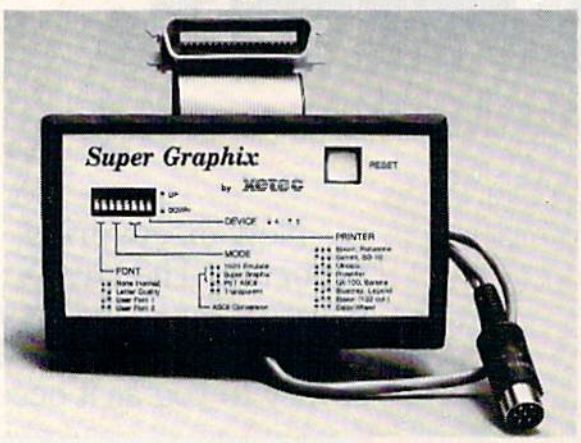

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ter and the pattern to be matched on the right. The computer randomly selects blue and orange squares, and places them on the game board. Because the choices are random, there are over 500 possible initial configurations for each pattern.

A flashing cursor appears at the center of the game board when play begins. Select the square you wish to change by moving the cursor with the joystick to the square and pressing the fire button. Only the orange squares may be changed. If you press the fire button while on a blue square, nothing happens. Choosing one of the four corner squares (1, 3, 7, or 9) reverses the color of that square and the three adjacent squares. Choosing an edge square (2, 4, 6, or 8) reverses its color as well as the two adjoining corner squares. If you select the center square, its color is reversed and so are the colors of the four edge squares.

1	2	3
4	5	6
7	8	9

Don't worry if at first it takes a long time to solve the puzzle. There's no limit to the number of moves you can make. A message will inform you when you solve the puzzle. In games 2–5, be careful not to change all the squares to blue. If you do, there are no legal moves available—remember, you can't reverse a blue square—and the game ends. It's suggested that you tackle game 1 (UNI-COLOR) first. It's the easiest of the five. When you've mastered this one, try the others.

Strategy

You'll probably develop your own way of solving the puzzles, but if you can't seem to get anywhere, try to establish some sort of symmetry on the board and then make moves which maintain that symmetry. This will make it easier to solve the puzzle, since all the goals are symmetrical.

See program listings on page 117.

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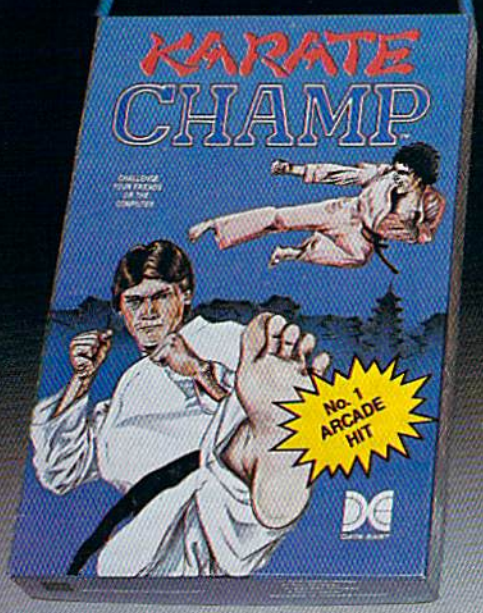

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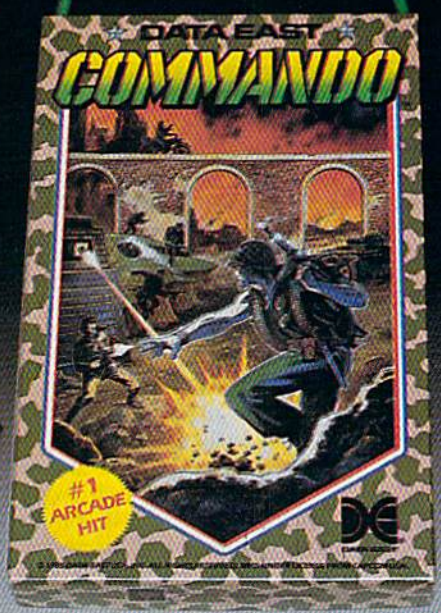

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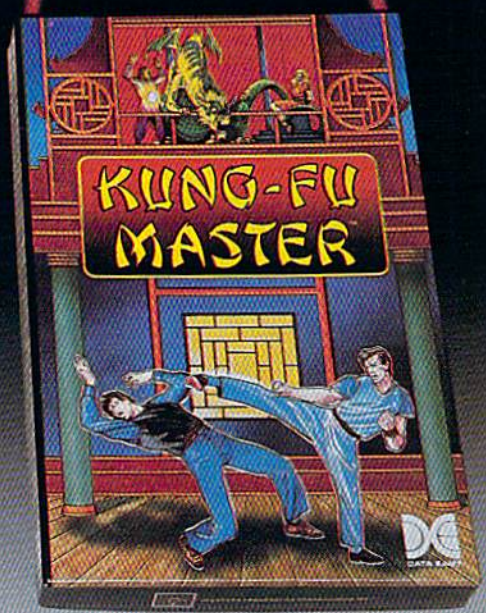

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Vizawrite Classic 128

Vizawrite Classic 128—written by Kevin Lacy, author of *Omniwriter 64* and *Vizastar 64*—may just be the most powerful word processing tool presently available for the Commodore 128. Frankly, it's hard to imagine needing a word processor to do something that *Vizawrite* cannot do. Besides having all the standard word processing features that users have come to expect, such as moving, copying, and deleting blocks of text; searching and replacing words and phrases; and centering, justification, and highlighting of text, *Vizawrite* has many extraordinary features. Those include the ability to do newsletter-like columns, a glossary of frequently used words and phrases for quick insertion, onscreen highlighting of text (boldface and/or underline), and automatic formatting of each page as you type. Except for certain text enhancements, such as italics, *Vizawrite* is a "what you see is what you get" word processor, permitting you to see onscreen what your document will look like when printed out. *Vizawrite* has over 59K of text memory, enough for a 25–30 page document. Of course, the program can link multiple files for creating extra long documents. To top it off, all of these features are in the 128's 2 MHz fast mode and are displayed in 80 columns.

In addition to these many advanced word processing features, *Vizawrite* provides a great degree of control and flexibility over the system. You can easily customize the display colors to your own choosing, and when a screen is customized and the file saved to disk, the color choices are saved along with it. A built-in calculator with memory is available from a single keystroke, as well as online help windows that you can customize. A full range of disk commands is available from within the program—you can format new disks; save, scratch, and verify files; and perform any DOS commands available from BASIC 7.0 (such as switching a 1571 from single-sided to double-sided format and vice versa).

Vizawrite allows you to take full advantage of your printer's capabilities by employing a "printer profile" system allowing you to create a custom printer profile to meet the exact needs of your printer. The program then allows you to go through an extensive series of options to define exactly what you want to print. *Vizawrite*'s use of the printer is so extensive, however, that setting up a file to print the way you want may take some time initially. Between working through all the options and figuring out which are appropriate for use with your printer and the document in question, preparing to print is not simple. Fortunately, once you've completed the exercise, your choices can be saved with the file. I found it useful to set up the desired printing options (and screen colors) and save a blank file to disk. Then before creating a new document, I load in the blank file containing the desired options and save the time and trouble of setting up the options for every new document.

An additional printing capability of *Vizawrite* is its built-in proportional and near-letter-quality (NLQ) fonts. The program offers four different proportionally spaced fonts and three different NLQ fonts. However, I could not get all of the proportionally spaced and NLQ fonts to work with my Epson printer. Also, the NLQ fonts only permit 49-1/2 lines per page, as opposed to the standard 66 lines per page. The fonts that worked with my Epson looked extremely good. In fact, the *Vizawrite* user's manual was produced using the program's NLQ fonts.

Usually, the price of such power and versatility in a word processor is complexity and difficulty of use. However, *Vizawrite* does an admirable job of making itself relatively easy to use. *Vizawrite* utilizes a command bar at the top of the display screen and drop-down menus for most file, disk, printing, and utility commands. To activate the command bar, simply press the Commodore key; then use the cursor and RETURN key to drop a particular menu down into its subcommands. From there, you again use the cursor and RETURN keys to activate the desired subcommand. However, once you become familiar with the commands available, you can employ a much faster command execution by simply pressing the Commodore key and then the key corresponding to the first letter of the words representing the desired command and subcommand.

The word processing commands are fairly standard, using function and control keys. There are two quirks that may represent differences between European and American command conventions. First, the DELete key erases the character on which the cursor is placed. Second, commands executed with the CONTROL key (such as CONTROL-E, which begins and ends the boldfacing of a portion of text) are accomplished by pressing CONTROL and releasing it, then pressing the E key. The most common convention requires holding down CONTROL while pressing the other key to complete the command.

The formatting of text is accomplished by the use of embedded codes and what *Vizawrite* calls a *format line*—a dotted line that appears above the text to be manipulated by the desired format commands, such as tabs, margins, line spacing, column setting, and page breaks. Additionally, special printer codes can be defined on a format line, allowing the user to embed the necessary codes in the text to produce special characters or text enhancements, such as international characters, italics, and super- or subscripts.

While the embedded codes, format lines, and faint dots *Vizawrite* places in text between words—and wherever else the user leaves a space using the space bar—may be visually distracting, *Vizawrite* provides the option to hide such formatting symbols. You simply press CONTROL and then H, and the formatting symbols are "hidden" on the screen, thereby permitting you to view your document almost as it would appear when printed on paper. I say *almost* because some text enhancements are not displayed on the screen, such as italics, condensed print, superscripts, and subscripts. Seeing your document as it will appear on paper as you are editing is a tremendous feature in a word processor—one that cannot be overstated. Besides allowing you to be more creative while writing, the hide option saves you a significant amount of time because you don't have to switch between an edit and a preview mode or print out the document to see how it will appear on paper.

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Yet another great feature of *Vizawrite* is its integrated 30,000-word dictionary, which allows you to access the spell-checking functions from the command bar without having to save your document file to disk before checking the spelling. The spell-checking abilities include listing the words in your document alphabetically, according to usage, and by unrecognized words. Provided are several utilities which allow creation of a user dictionary for specialized use, and expansion and restructuring of the existing dictionary.

The package includes a disk containing the *Vizawrite* program on one side and the dictionary on the other, and a cartridge for the user port. Since the cartridge must be in place before the program will load, the disk is supplied to the user without copy protection. This enables you to easily make backup and working copies of the program and dictionary files. I must note, however, that I'm not crazy about having to plug in the cartridge every time I want to use the program. Between the *Vizawrite* cartridge, a cartridge to use *Vizawrite 128*, and my fast load cartridge, I find myself pulling cartridges in and out much more often than I'd like.

The program works with either a 1571 or 1541 disk drive, but is fairly slow to load even on the 1571. Once loaded, however, the program disk is no longer needed, thereby eliminating most of the disk-swapping headaches of a single-disk-drive user. In fact, the program is almost easier to use with a single disk drive. While *Vizawrite* allows the user to define which drive the program should look to, it does not allow simultaneous use of two disk drives. Frankly, I find it easier to flip the lever on the disk drive and switch disks than to remember the command to switch to a different drive number.

Vizawrite is not a program you can load up and use immediately. Fortunately, it comes with a fairly well-written and concise manual, as well as a couple of example document files on the program disk. While infrequent users will probably find themselves leafing through the manual periodically to refresh their memory on certain commands, the frequent user should be able to shelve the manual after the first few documents produced.

All in all, *Vizawrite* is a top-notch program. Its power, versatility, and design leave little room for disappointment. It could become a, if not *the*, word processor of choice for the 128. The only noticeable shortcoming is the absence of an option to use a 40-column display, which makes the program unusable to 128 owners with a 40-column monitor. Solid State Software has indicated that enhancements to *Vizawrite* are in the works that will enable it to take advantage of the RAM expanders for the 128 as RAMdisks, and to add a font editor permitting you to define your own font styles.

—*Scott Thomas*

Solid State Software
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Nine Princes In Amber

An interesting recent development in interactive fiction is the adaptation of novels into computer text adventures. While Infocom's *The Hitchhiker's Guide to the Galaxy* is among the most famous of these, Telarium Software has specialized in them from the beginning. With early titles such as *Fahrenheit 451*, *Rendezvous with Rama*, and *Dragonworld*, Telarium has had plenty of experience bridging the two fields.

Nine Princes in Amber for the Commodore 64 demonstrates the pros and cons of such an enterprise. Based on the first two novels of Roger Zelazny's well-known Amber fantasy series, the story takes you, in the role of Corwin of Amber, through many adventures on your hopeful path to the Amber throne. You begin, like the Corwin of the book, in a hospital bed, the victim of amnesia, and from there you play out many of the book's most important scenes. You meet your siblings—Eric, Random, Flora, Deirdre, Julian, and others—whom you try to ally with you in your quest for the throne. On the way you must learn the art of fencing, and you must successfully walk the Pattern of Amber.

If you understood the previous paragraph, you'll enjoy Telarium's product. You have also read the books. If you didn't understand the paragraph, you still might enjoy the product, but that is nearly impossible to predict. The major difficulty in adapting novels to interactive fiction is, I think, finding the balance between those who know the original and those who do not. If the adventure slavishly reproduces the novel, players who know the story will quickly become bored. But if knowledge of the original is assumed, players who have not read it will easily become confused. *Nine Princes in Amber* reflects these problems, but in the end it is a creditable adaptation.

When I first tried the interactive version, I had not yet read the original. The whole thing was very strange to me, but after a while I gained a feel for Zelazny's world and an interest in Corwin's situation. But then I hit a snag, a puzzle I simply could not solve. So I did the only reasonable thing: I gave up. Restoring games with the 1541 drive encourages surrender.

Then I read Zelazny's books, and I decided to return to the game. Everything became, of course, much clearer, and I began to move through the story very quickly. I even got past the snag, because it is something Corwin experiences in the novel. Suddenly, though, I realized I was doing everything perhaps *too* quickly; having read the books, the challenge simply wasn't there. I began to wonder if I was going to just walk through the entire thing.

Walk Shadow to Arden
You begin to notice strange things happening to the world outside the car... the countryside is scattered with large, slowly turning windmills...a sudden and violent thunderstorm, strangely colored clouds rolling overhead. A vast desert surrounds you...the roadway begins to sparkle.

As it turns out, I didn't. After a certain point, the adventure veers significantly from the course of the book. A new plot emerges, reminiscent of the original, but not merely a clone. You still play the role of Corwin, but Corwin's new tasks differ from his original tasks. But then I began to wonder if an Amber newcomer, one who had never read the books, would ever have made it this far. I know I wouldn't have, and I suspect the same is true for others. Still, even for newcomers, the story is a good one, and those who hit snags can always run to the library or the bookstore and read the original.

Nine Princes, then, combines the established story with a new one. In doing so, it finds the balance between Amber newcomers and Zelazny veterans. Newcomers can play and enjoy the game, albeit with a fair bit of difficulty, and veterans will find something new to interest them.

The game has two outstanding features. First, it uses a large vocabulary for interaction and diplomacy. Conversing and dealing with other characters is simple and interesting. Second, at certain points you enter the fencing game, with commands such as Parry, Thrust, and Feint that really work. Impressively, both features are as essential to the game as they were to the novel.

Because these features, along with the adherence to the original story, show the game's faithfulness to the

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novels, *Nine Princes in Amber* is a worthwhile adventure game. With added touches such as graphics screens of important scenes, and occasional bursts of music, the game captures quite nicely Roger Zelazny's weird and unpredictable world. I suspect it will appeal most to veterans who have not read the novels for a while, but newcomers and recent readers should also find it worth looking at.

—*Neil Randall*

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The Music System And The Advanced Music System

From Firebird come *The Music System* and its big brother, *The Advanced Music System*, the latest and perhaps most comprehensive single-disk "music processors" for the Commodore 64. Intended for musical hobbyists, both packages are thoughtfully designed and well-produced, and they sport excellent documentation, including many helpful diagrams.

Both systems are substantial and complex. You'd need to spend some time and effort on both programs, as you would with any complete system of this scope. Outstanding features include extremely clean hi-res graphics and Macintosh-style pop-up menus and icons. The programs also function well with monochrome monitors, and joysticks are not required. Icons and other graphics insure that anyone with minimal musical background may approach these systems—another real strength, which should also facilitate use by those whose primary language is not English. The advanced system will even insert bar lines or automatically correct them for you.

The systems are operationally well-conceived. Four function keys access standard sets of menus throughout (Files, Values, Commands, Info). And the space bar advances you clockwise (or counterclockwise) around the screen to access the various *devices* pertinent to each program or to highlight a desired menu selection. Pressing RETURN enters your choice. The RUN/STOP key always starts/stops sequence play. And the Commodore–RUN/STOP key combination initiates record mode.

Below this level, things get more complicated. It's difficult to remember which key(s) to press for what. Where options are most numerous—in *The Advanced Music System*—a most welcome "Quick Key Reference Guide" is provided. (An innovative, but more expensive solution would be to create a custom input device, such as a touch tablet. It seems that many special-purpose systems would be friendlier with similar peripherals.) Lacking such a device, *The Music System* designers might have implemented the more intuitive back arrow and cursor control keys—the latter remain unused in either package.

The basic *Music System* package consists of two modules—a keyboard/editor and a synthesizer—one on either side of the disk. Both modules contain sequencers. The programs write and access the same music and sound files, and the systems are 100-percent compatible. Synthesizer modules in *The Music System (TMS)* and *The Advanced Music System (AMS)* are virtually identical. In *AMS*, the keyboard and greatly expanded editor are separate, however. Additionally, *AMS* includes linker, printer, and MIDI programs—all accessed through a master icon menu. These add-ons expand system capability, but the *TMS* basic system is complete and workable on its own. It's also much more approachable for the beginner.

The keyboard modules allow you to enter—either in "tinker" or record mode—notes and rhythms from the top two rows of Commodore 64 keys. This arrangement gives immediate access to almost two octaves of pitches. Octave shifts higher and lower are available—as are a number of other options—by pressing special key combinations. It is these combinations that are difficult to remember. One voice only may be performed at a time. On playback, you may select up to three voices. An ever-present visual metronome icon—with variable tempo—keeps you in time, to three varying degrees of resolution. In *AMS*, it optionally "clicks" if a voice is available to play it.

You may watch the single voice you play through the Voice Monitor Window. In *TMS*, you can also view all three voices on playback. This is the same window through which you edit: add, delete, change bar lines, pitches, rhythms, and instruments (which can be redefined at any point—an important feature). *AMS* doesn't use this window to edit since it has a separate editing module.

The keyboard/editor module in *TMS* is a most useful hybrid. Of course, it's appropriate in *AMS*—where editing tasks become more comprehensive—for this process to be handled separately. Although your effort must be painstaking, you can optionally enter compositions note by note through the Voice Monitor Window, one voice at a time. Most users will probably choose to play "rough draft" tracks on a keyboard (synchronized aurally to previous tracks and visually to the metronome) and then polish things with the editor.

Whereas music/sequence files are saved from the keyboard and editor modules, it's the synthesizer module that creates sound files. Sound files are groups of 15 "instruments" (waveform/envelope combinations) and four sets of filter parameters. A single filter setting is available to all instruments simultaneously; it may be switched in or out for each instrument as desired. Although only one sound file is active at any given time, a second is coresident in memory and may be manually "swapped" on a moment's notice.

Experienced music hobbyists may miss the presence of ring modulation (there is no way of getting bona fide bell tones), sync, and voice 3 envelope and oscillator modulation. Perhaps this is why the packaged sound files (two in *TMS*, three in *AMS*) tend to sound rather bland and unexciting. Also, there is no way to tune voices to near unisons, for a rich, chorus effect. Filter cutoff points are preset by the user and cannot "track" oscillator pitch.

However, this just opens the door for perhaps the most innovative device contained in *TMS* and *AMS*—the Dynamic Response Envelope (DRE). The DREs are three-stage control-envelope contours, available either once per event (note) or repetitively. There are two of them *for each instrument*: one modulates pitch and/or pulse width; the other, filter contour. Each stage is expressed in terms of number of steps (time), slope of curve (rate), and step time (overall speed); they roughly correspond to envelope segments (and programming) on Casio CZ keyboard synthesizers. (Slower step times can create a limited range of "sampling" effects.) As useful as this capability is, it's too bad that there are only three stages (a simple pulse modulation, like a modern police siren, requires four stages), and that the contour ceases automatically at the onset of the note's release stage. This should be an option, not automatic.

The *advantage* of the DRE approach to modulation over the traditional "voice 3" method is that it allows three-voice harmony to continue, and that all voices may be modulated simultaneously, even with contrasting contours.

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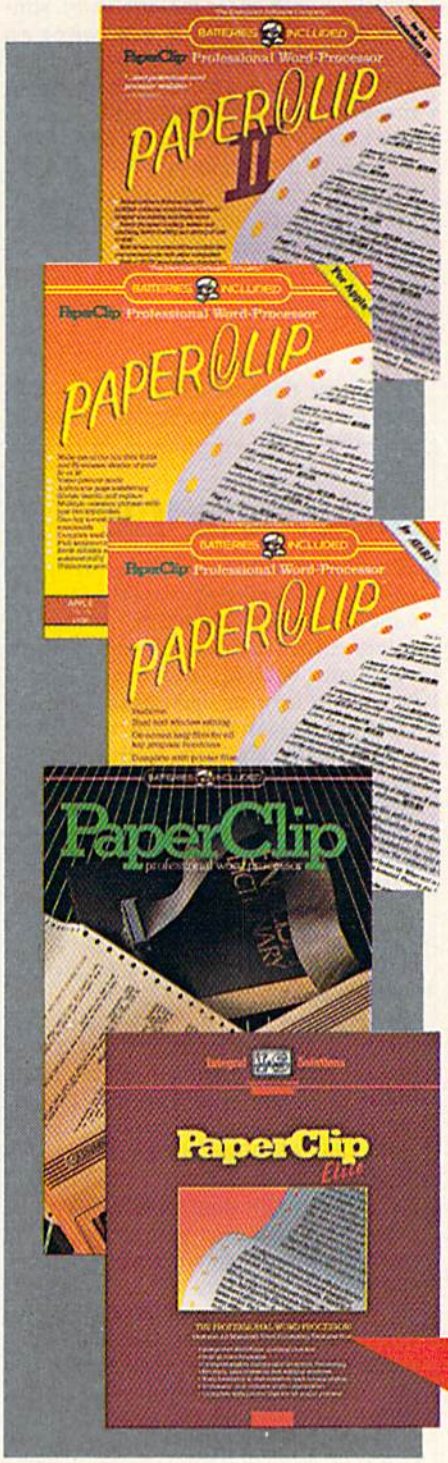

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the synthesizer module is its ability to repeat sequences infinitely while you try out different instruments. It's like changing instrumentation while the piece is playing—a real arranging tool. Of course, there is also a key to press for a single tone or repeats thereof (you may specify pitch and duration).

In *AMS*, editing capability is greatly expanded to include the handling of triplets (notably missing in *TMS*), multiple repeat structures and "loops" (infinite repeats of specified sections), and "macros" to facilitate the editing of *groups* of notes (even complete voices). Also included is a "notepad" file which can be separately saved to facilitate moving material among voices, repositioning it or copying it, and so forth. In contrast to *TMS*, the editor transposes *in notation* as well as in sound.

Don't look to *AMS* for anything fancy in terms of MIDI capability. However, the basics *are* covered. You'll need a SIEL or Passport MIDI interface plus a MIDI keyboard. With them, you can enter data from an external keyboard one voice at a time, edit the MIDI music files, and then play them back through the MIDI keyboard. Unfortunately, for editing, files must be converted from MIDI type to the normal *AMS* format. Whereas MIDI allows up to six tracks, *AMS* files are limited to three *voices*, and they eliminate much important musical information (such as pitch bend, slides, after touch, modulation). Each MIDI track is limited to one voice, and only one MIDI keyboard can be controlled by the sequencer at a time. As a simple sequencer storage device, and for keyboard pitch and rhythmic input, the MIDI module would seem most useful. I am unaware of comparable hobbyist-oriented packages which offer this feature.

The *AMS* linker module allows you to create link files, which are collections of individual music files. Longer arrangements, with complex sectioning, are thus possible.

Finally, the printer module permits hi-res dot-matrix printing of one to three voices, at the rate of 10 to 15 minutes per page. Commodore and Epson (Epson-compatible) printers are supported. Although printing details are especially clean, the result is only marginally useful since each voice is widely separated from the others and is printed on a double (grand) staff rather than on a single line. (Note that, with three voices, there is only one system per page.) This module also includes a text option, where you add text to the lead voice. Text is saved as a separate file, and several useful spacing options are provided. One limitation is that text is printed out only (optionally) under the top voice.

Here are my recommendations. If you primarily want rich and/or "wild" sounds, are looking for a full-featured MIDI sequencer/editor, or are a professional composer/arranger, these products are not for you. But consider *The Music System* seriously if you are an average hobbyist seeking a reasonably priced, single-disk music package to experiment with or for making short, simple arrangements. If you want an introduction to MIDI (wish to use a *real* keyboard) or want to make longer, more involved arrangements, take a good look at *The Advanced Music System*. (A $40 upgrade to *The Advanced Music System* is offered with the basic package.) Both are solid, state-of-the-art pieces of software.

—Art Hunkins

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Superbase 128

Superbase 128 is a database designed specifically to take advantage of the advanced features of the 128. As such, it offers a lot: full 80-column display, automatic booting, and formatting of both sides of your data disks (with the 1571 drive). And to keep everything both readable and easy on the eyes, the default screen colors are green on black, emulating a monochrome monitor. Rather suddenly, your computer is displaying the power you knew was there. But now what do you do with it?

If you haven't yet used a database, a few definitions are in order so that you'll better understand the features to be evaluated.

The smallest part of a database is the *field*. This is one item of information, such as a name. Multiple fields make up a *record*—for example, the address, phone number, amount owed, and so on. Multiple records comprise a *file*. Ideally, all records in a file will have a common denominator, such as everyone who owes you money. And multiple files—everyone you know—comprise a database.

Uses for a database go far beyond merely keeping lists of names and addresses for your Christmas card list. Depending on how powerful a base is in allowing you to manipulate fields, records, and files, it may also be useful in building an invoicing system; keeping a "preferred customer" list complete with date and amount of last purchase; and cataloging your collection of Barbra Streisand albums with information on composer and lyricist of each song, as well as the writer of the liner notes.

Fortunately, *Superbase 128* has the power to do all this and more because it is a programmable database. And being programmable means that it has a great deal of flexibility, not only in creating records, but also in accessing information from records once they have been stored.

If, for example, you want your Deadbeat file to print out (to screen or printer) everyone who owes you more than ten dollars, it is easily done. Or, if you want to access your invoice files to find out how many widgets were sold between May and July of 1985, the number of multiple sales, the number of repeat customers, and the average cost and selling price per widget, it can be done.

The key to doing all this is in two parts: designing your files at the field level, and being able to write a program that will tell *Superbase* which file to report on and which fields to manipulate.

For the former, *Superbase* allows for easy creation of records. From the first menu screen, you select Edit and are then presented with an almost blank screen. Type the title for the field, such as Lastname; specify the type of field (text); then set the length of the field according to the maximum amount of information you may have to enter (up to 255 characters for text, up to nine digits for numeric).

When you get to a Date field, define it as such and it will accept no other type of information. (If you use the Calendar designation, entering any date in this century will cause *Superbase* to supply the day of the week.) Similarly, a Numeric field is designed to accept only digits and may include up to four decimal places. Use this for amount owed in your Deadbeat file.

You can go on with this for quite some time: Each record can contain as many as 127 fields and comprise as many as four pages (screens) of information. Further, *Superbase* places no limits on the number of records that can be contained in a file. Think of this as a constantly expanding file cabinet; each time you add a new folder, the cabinet grows to accommodate it.

If a record is to contain calculations, you'll also want to specify a field to hold the result of those calculations. Once you've finished and saved the form of such a record, you'll be prompted for a calculation for the Result field. In the case of our Deadbeat file, we could answer the prompt with:

```
[balance] = [amount owed] - [amount
  paid]
```

This example illustrates the programmable part of *Superbase*, and it can be as simple as that. Dozens of new,

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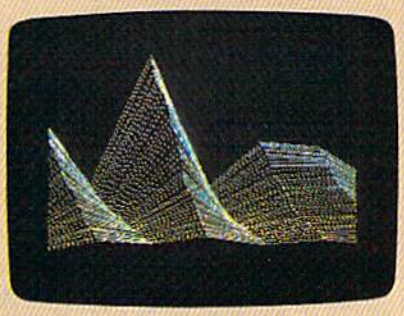

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plain-English commands have been added, and you'll be able to use all the math operators you've used in your other programming endeavors.

Once a file of records has been created, you'll need to specify the type of information you wish to extract. Though the menu offers an Output option, this prints each record in full (to screen or printer)—and this may not always be desirable.

For those times when you may want to see only the most pertinent parts of a record, there's an easy-to-use Report Generator included in *Superbase*. Answer the prompts concerning file to work on, calculations, breaks and subtotals, and so forth, and the generator builds a BASIC program that will manipulate the information just as you want it to be manipulated.

To check this out, select Program from the menu and you'll see your report in program form, complete with line numbers. As with any BASIC program created on the Commodore, full-screen editing allows you to alter or add to the program as you wish.

While the documentation of over 200 pages does all it can to provide clarity and detailed instructions, it does fall somewhat short as a reference tool. The novice, following the step-by-step instructions in the three extensive tutorials, will be able to create an address list, a simple invoicing file, and a more complex invoicing file—but only exactly as stated in the book. For any kind of report generation that is not detailed in the documentation, you must have something more than a nodding acquaintance with BASIC.

In storing records, *Superbase* operates on a "key field" basis. Any field in a record can be specified as the key, and in our Deadbeat file we would probably want that field to be LASTNAME. Though the explanation is simplified, think of it this way: When a record is completed and stored, a separate directory consisting of only the key fields is set up on the disk. To access the record, specify the last name. *Superbase* picks it out of the key directory and finds a pointer leading to the full record. It is in this way that *Superbase* can retrieve a record in 0.3 seconds—and that's fast.

You may direct that your sort be on a field that is not the key field, but retrieval will not be as fast. You may also do multiple sorts on as many as 34 fields: With this feature you could call up the records of those who owe you money; who live in zip code 63146; who have blue eyes; and who part their hair on the left side. And that is only four fields deep. Complex sorts require more time.

I also like the manner in which a record is entered. When it's complete, storage is to disk rather than to RAM. While this process takes a few seconds more than simply storing the record in memory for later storage on the data disk, the time would certainly be worth it in the event of a power failure or a system lockup: Everything done up to the time of the crash would be saved.

Superbase 128 was created by Precision Software and is marketed by Progressive Peripherals & Software. Precision also developed *SuperScript 128* for word processing (also marketed by Progressive Peripherals), so it's not surprising that the two programs are integrated. With such an arrangement, it's possible to design a database report that picks out only the names and addresses from a file (and only the addresses within a particular zip code if you like) and affixes them to form letters created with *SuperScript*. A nice surprise is that *Superbase* can also work in this way with Commodore's *EasyScript* as well as with other word processors that create sequential files.

To sum up, *Superbase 128* is a powerful database, one of the most powerful available for Commodore computers.

—*Ervin Bobo*

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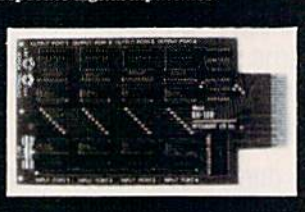

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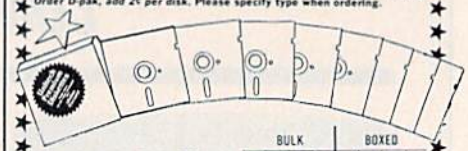

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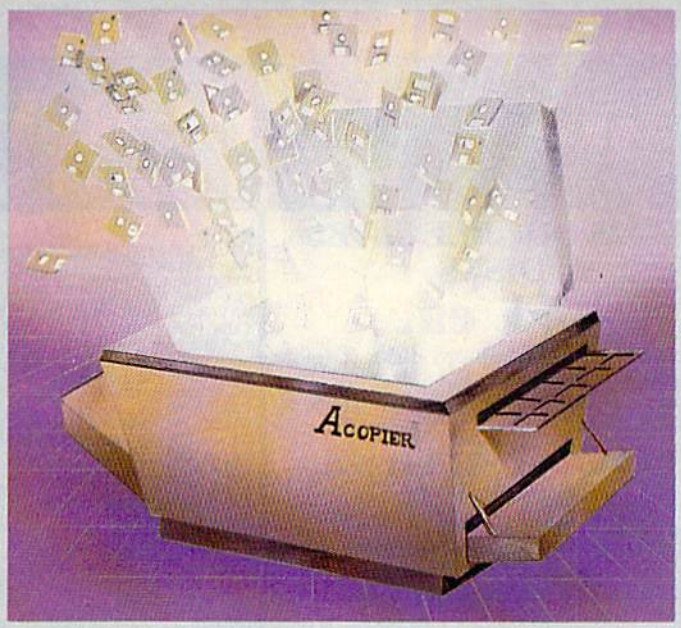

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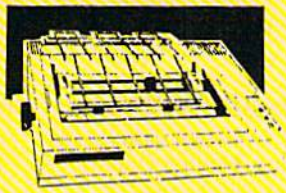

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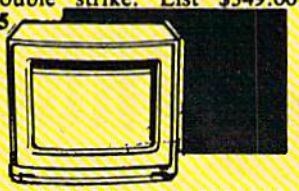

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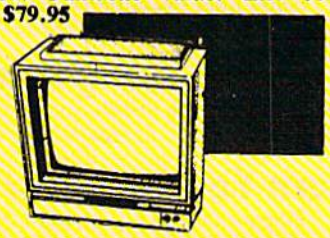

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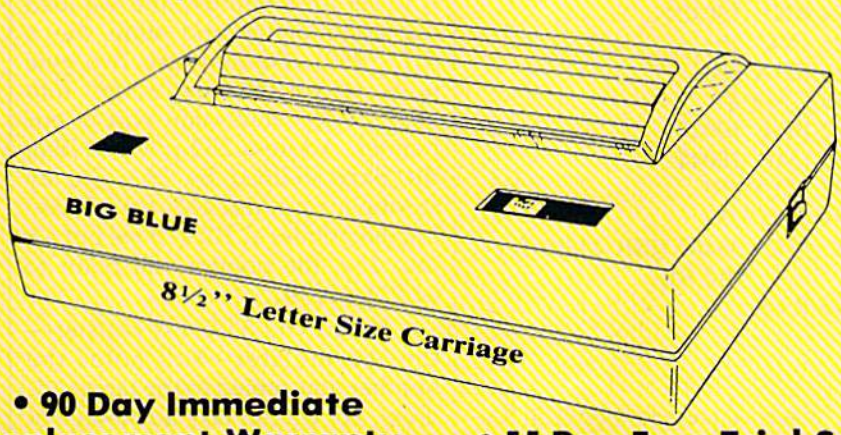

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machine language for beginners

A Practical Program

Richard Mansfield
Senior Editor

Last month we started using the primary tool of machine language (ML) programming: an assembler to create executable programs. Now let's put our assembler to work and write a program for the 128 and 64 which will test RAM memory.

The program will POKE in every possible number (0–255) that can be held in a RAM memory cell, and it will then check to see whether that number really made it into the cell to which it was POKEd. Aside from allowing you to spot defective RAM chips (the routine will report the address of any offenders), it will allow us to explore some fundamentals of ML programming. This month we'll set it up to test screen RAM so that we can see it working (128 users should set the screen to 40-column mode).

Take a look at the "Screen Test" program below. When you first start to learn ML, the three-letter codes which are its commands seem quite mysterious. Actually, there are about as many commands in ML as in BASIC and, as you would expect, you'll use only about 20 of them most of the time. However, where BASIC spells out command words, ML abbreviates. For example, RETURN in BASIC is the equivalent of ML's RTS (ReTurn from Subroutine) command; BASIC's X = X + 1 becomes INX (INcrement X); and GOTO becomes JMP (JuMP). But you get used to these abbreviations very quickly.

If you're using the simple assembler published last month, give 10000 as the start address of this program and then type in the three-letter ML commands in the program. Note the different number at address 10041 required for the 64. If you're using a different assembler, insert a comma between the right parenthesis and the Y in lines 10010 and 10012:),Y.

When you're finished, you can SYS 10000 to test it. The screen will be POKEd with all the possible characters—but it will happen too fast to see. After each cell has been tested, the letter *A*, the last POKE, will remain behind.

Screen Test

```
10000 LDA #4
10002 STA 253
10004 LDA #0
10006 STA 252
10008 TAY
10009 TAX
10010 STA (252)Y
10012 CMP (252)Y
10014 BNE 10037
10016 DEX
10017 BEQ 10023
10019 TXA
10020 JMP 10010
10023 INY
10024 BNE 10010
10026 INC 253
10028 LDA 253
10030 CMP #8
10032 BNE 10010
10034 JMP 10044
10037 LDA 253
10039 LDX 252
10041 JSR 36402 (JSR 48589 for
      the 64)
10044 RTS
```

A Feel For The Language

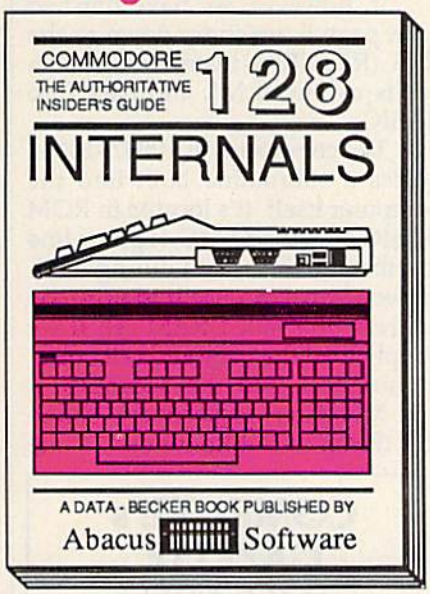
Let's now go through the program step by step to get a feel for how the language works. We start off by putting a 4 into address 253. Address 253 is going to be a *pointer* into memory. It will always hold the *page* of the address being acted upon while we PEEK and POKE during the program. Memory can be conveniently divided into 256-cell chunks called pages. So, by putting a 4 into our pointer, we're directing the action to the fourth page (4 * 256 is 1024, the start address of the screen RAM cells in the 64 and 128).

When you want to POKE a number in ML, you must first enter that number into a *register*. The accumulator is the most often used register. We LDA (LoaD the Accumulator) with 4 by using the # sign before the 4 to show that we mean the *actual number* 4 rather than whatever number might be currently held in *address* 4. So our first job is to set up a pointer, and we load the accumulator and store the 4 (STA 253). Pointers are two-byte units, so we then put a zero into 252, the less important part of our pointer. Address 252 points *within* the page defined by 253. So, by storing a zero into 252, we're leaving the pointer at 1024. If we put a 6 into 252, the pointer will point to address 1030.

When you STA, the register—the accumulator—still holds the number you copied to the target address. So, we can take advantage of this by transferring the zero still sitting in the accumulator to the X and Y registers by TAX and TAY. We could have used LDX #0 and LDY #0, and the effect would have been the same; we just took a shortcut.

We're zeroing X and Y because we're going to use them as loop counters. You don't have FOR-NEXT commands in ML, so you set up your own counters. Our main loop starts with STA (252)Y, which causes whatever is in the accumulator to be stored into the cell *pointed to by the pointer* we set up *plus the value of Y*. In this first pass through this command, Y is a zero, so a zero is stored in address 1024, and we then compare what's in the cell to what's still in the accumulator (CMP). They should be the same unless RAM is faulty and can't accept the zero we just stored there.

One good book... deserves another... and another...



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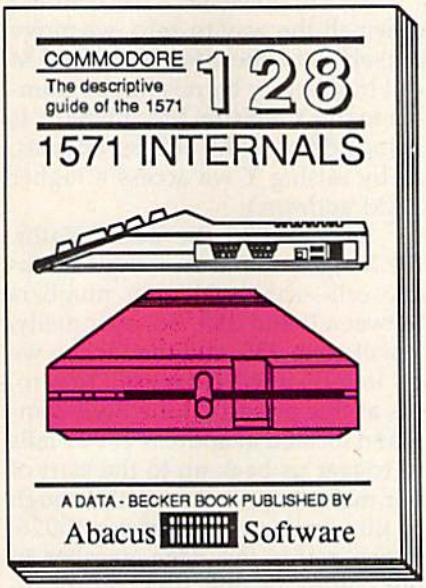

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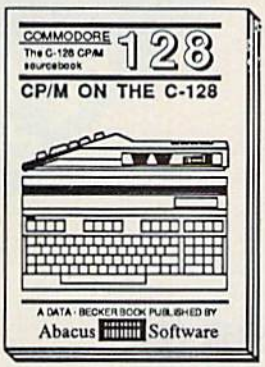

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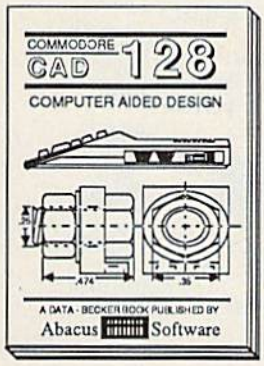

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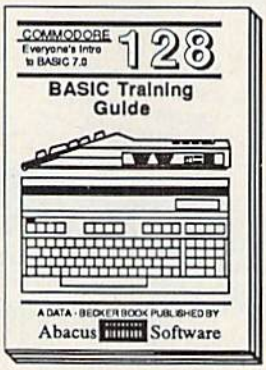

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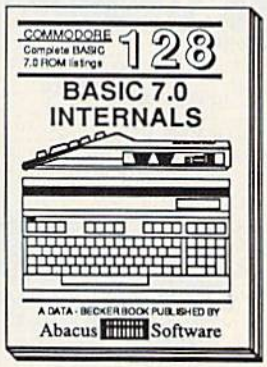

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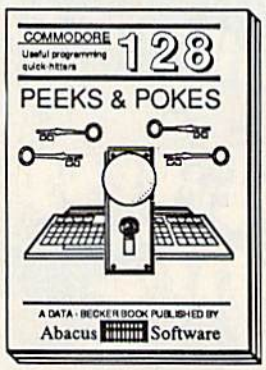

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GOTO And NEXT

If there is a failure, we are sent off to an error-reporting subroutine at address 10037 within our program. BNE means Branch if Not Equal. It causes the program to GOTO its target address if the previous action (the CMP in this case) was not equal. In other words, if the number currently in the accumulator is not the same number discovered in the RAM cell sampled by the CMP, the branch takes place. Conversely, if the compared numbers are equal, the program passes right over the branch and ignores it. An ML branch, then, is the equivalent of IF-THEN-GOTO.

Now we come to the ML equivalent of BASIC's NEXT command. DEX reduces the X register by one, and BEQ (Branch if Equal to zero) tests to see whether the X register has reached zero yet. If so, we are branched out of this loop and sent down to address 10023. However, while X is still counting down, we don't want to branch, so we transfer the value of X (the next number we're going to be POKEing into the RAM cell currently under test). Then we jump back up to the start of our POKE-PEEK loop at 10010.

When, however, X has counted down all the way to zero, we move ourselves to the next higher RAM cell in memory by raising the number in the Y register. (Recall that Y is being added to the pointer address, so by raising Y we access a higher RAM address.)

But Y—like the accumulator, the X register, and any single memory cell—can hold only numbers between 0 and 255. So, eventually, Y will go to 255, and then when we try to INY, it will reset itself to zero. It's at this point that the BNE command located at address 10024 fails to trigger us back up to the start of our main loop, and we fall through to the command at address 10026, which raises the page number in our pointer by one. (INC means increment.) Then we load the page pointer into the accumulator and check to see whether it is yet an 8 (which would mean we've reached the bottom of screen RAM). If not, we return to loop through the next page (we just INCed the page pointer, so now we're ready to test a new, higher 256-byte-size chunk of RAM).

If, however, we have finished with page 8, we jump down to the RTS (RETURN) instruction which sends us out of ML and back into BASIC.

The commands at 10037–10041 access a subroutine built into the computer itself. It's located in ROM BASIC and, for BASIC, it prints line numbers to the screen during LIST. However, we can use it to print the address of a failed RAM cell if we simply load the page and cell pointer numbers into the accumulator and X register, respectively, before JSR (Jump to SubRoutine). ■

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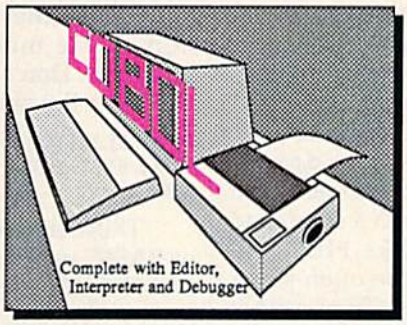

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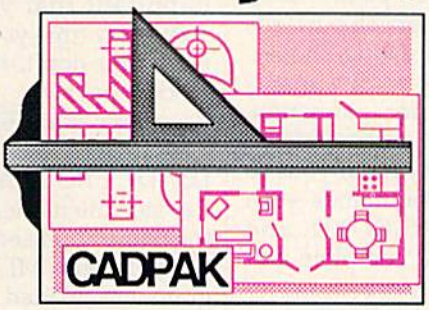

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Fill-64

Hubert Cross

This exciting graphics utility for the Commodore 64 adds 15 new commands to BASIC. "Fill-64" allows you to paint any solid shape on the hi-res graphics screen at a speed that's fast enough for animation. Once an animated sequence is complete, you can store the entire animation on disk or tape, to be replayed at a future time. No machine language knowledge is needed to use this program.

If you're interested in high-resolution graphics on the Commodore 64, you may have used programs that add commands such as PLOT and DRAW to BASIC. Most of these programs allow you to draw a closed shape on the screen with lines, then paint it with a command called something like FILL. Fill commands of this type often suffer from two drawbacks: They cannot draw over existing dots on the screen, and they are much too slow for animation.

"Fill-64" lets you paint a solid shape anywhere on the hi-res screen, even over existing shapes. The program works so fast that it can even be used for animation. Since it adds new commands to BASIC, Fill-64 is easy for anyone to use. With simple commands such as FILL, CLEAR, RECORD, and PLAY, you can draw complete animated sequences, store them on disk or tape, and redisplay them at your convenience.

Typing It In

Fill-64 is written in machine language and must be typed in with "MLX," the machine language entry program found elsewhere in this issue. However, no machine language expertise is required to use the program. Read the MLX instructions carefully before you type Program 1, and be sure to save a copy when you're done. Here are the addresses required for Fill-64:

Starting address: 83FF
Ending address: 981F

Before loading Fill-64, you must enter the following lines in immediate mode (with no line numbers). Don't forget to press RETURN at the end of each line.

```
POKE 51,255:POKE 52,63
POKE 55,255:POKE 56,63
NEW
```

These statements move the top of BASIC memory down to a point 24,577 bytes lower than usual. That leaves 14K for BASIC programs, more than enough for most applications. The reserved 24K area is used to store Fill-64 and its data. It's very important that you perform this step every time you wish to use Fill-64; if you don't, the program can't work properly.

Next, load Fill-64 with LOAD "PROGRAM",8,1 for disk or LOAD "PROGRAM",1,1 for tape. Replace the name PROGRAM with the name you used when saving the program with MLX. When the program has loaded, type NEW and press RETURN to reset the computer's BASIC pointers.

To activate Fill-64, type SYS 33846 and press RETURN. Fill-64 makes two hi-res screens available at all times. When you first activate the program with SYS, it clears both screens and displays screen 1. Use the function keys to switch from one screen to the other. The f5 key displays screen 2. To return to screen 1, press f3. The f7 key clears the current screen, and f1 returns you to the normal text screen.

Fill-64 Commands

Fill-64 adds 15 new graphics commands to BASIC. Following is a summary of what each command does. Later sections of this article contain programming examples and additional information about these commands.

FILL ***number,color,x1,y1... xnumber,ynumber***

The FILL command paints a polygon of the specified color at the designated screen location. The first parameter (*number*) indicates how many vertices (corners) the shape has. For example, a triangle has 3 vertices; a square has 4; and so on. Use a vertex number of 1 to draw a dot; a vertex value of 2 draws a line. The second parameter (*color*) sets the shape's color, using the same color numbers explained in your user's manual. After these values you must supply an appropriate number of *x*- (horizontal) and *y*- (vertical) coordinate pairs. To draw a triangle, for instance, you need three pairs of *x,y*–coordinates, one pair to define each corner. This statement draws a triangle:

```
FILL 3,2,10,10,50,10,30,50
```

Notice that the FILL command automatically displays the hi-res screen. No special command is needed to switch from the text screen to hi-res.

SWITCH

SWITCH moves from one hi-res screen to the other. If you're in screen 1, SWITCH flips you to screen 2, and vice versa. SWITCH ordinarily erases the screen that it previously displayed. If you perform SWITCH from the text screen, Fill-64 displays screen 1 without erasing its contents.

FLIP

FLIP works exactly like SWITCH but does not erase the previous screen.

CLEAR

This command erases both hi-res screens. It's useful at the beginning of a program.

LOWRES

The LOWRES statement switches to the text screen under program control. In immediate mode (when you're not running a program) you can also do this by pressing the f1 key.

SETCOLOR ***border, background, hi-res1, hi-res2, hi-res 3***

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Sets the screen border, background, and three hi-res colors. The default colors for Fill-64 are white, blue, black, yellow, and white, respectively.

RECORD

This command records animated graphics sequences. It tells Fill-64 to "memorize" every graphics command that follows, until it encounters a REWIND or PLAY statement (see below). As a reminder, Fill-64 sets the border color to red whenever RECORD is active.

PLAY

Replays an animation previously recorded with RECORD or stored with DPUT or CPUT (see below). When Fill-64 is PLAYing an animation, it can be interrupted only by pressing RUN/STOP–RESTORE.

REWIND

Exits RECORD mode. In effect, this command "rewinds" Fill-64's recorder to the beginning, erasing any previously recorded animation.

MEMORY

Prints the number of bytes available for RECORDing animations.

DPUT *"filename"*

Saves an animation to disk. Replace *filename* with any legal Commodore filename.

DGET *"filename"*

Loads a previously saved animation from disk.

CPUT *"filename"*

Saves an animation to tape (the filename is optional).

CGET *"filename"*

Loads an animation from tape (the filename is optional).

Fill-64 Techniques

Program 2 demonstrates just a few of the effects you can achieve with Fill-64, from detailed kaleidoscopic patterns to three-dimensional animation. Program 3 loads and replays the animations created by Program 2, using the full speed of Fill-64's built-in machine language routines. Since these programs use Fill-64 BASIC commands, you *must* install Fill-64 as described above before you type them in (naturally, you must also install Fill-64 whenever you wish to run these programs). Once Fill-64 is active, press f1 to return to the text screen; then enter Programs 2 and 3 as you would any BASIC program.

Program 2 creates several different animations. For each animated sequence, the program switches into RECORD mode, then performs a series of FILL commands. Then it replays the animation with PLAY and optionally saves the animation. When you run Program 2, it asks whether you wish to save the animations. Answer yes (enter Y) the first time you run the program, and be patient—some of the more complex shapes take considerable time to calculate. Notice how much faster the animation proceeds when replayed with PLAY. When Program 2 has finished, you can run Program 3 to load and replay all the animations in rapid sequence. Together, these two programs demonstrate the complete process of drawing, recording, reloading, and replaying an animation.

Fill-64 has two limitations when painting. First, you can draw any solid polygon with as many as 18 vertices, but the polygon must be convex—that is, its inside angles must be equal to, or less than, 90 degrees. To draw a shape containing obtuse angles (angles greater than 90 degrees), break it down into two or more convex polygons. For instance, a star shape can be built from two triangles, one placed upside down over the other.

Second, although you may start defining the polygon at any vertex, you must proceed in a clockwise direction. The FILL command ignores any vertex written in a counterclockwise direction. This feature is extremely useful for eliminating hidden surfaces in three-dimensional objects.

Let's look at a simple example. This command paints a small triangle in color 2 (yellow):

```
FILL 3,2,10,10,50,10,30,50
```

The first value (3) indicates the number of vertices in the shape, and the second (2) indicates the color. The remaining values contain the coordinates for the triangle. This program shows how SWITCH flips from one hi-res screen to the other.

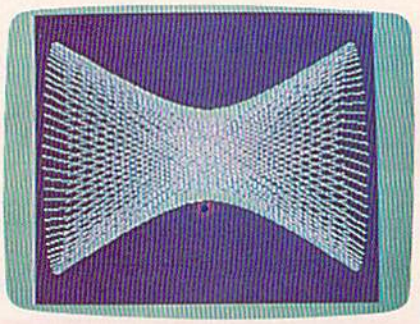
```
FC 100 FILL 3,2,10,10,50,10,30
       ,50
XD 110 SWITCH
CX 120 FILL 3,2,11,10,51,10,31
       ,50
HE 130 SWITCH
```

The triangle moves one pixel to the right. When an animation requires more than a few frames, you'll probably want to use a program loop. This example moves the triangle all the way across the screen with a FOR-NEXT loop:

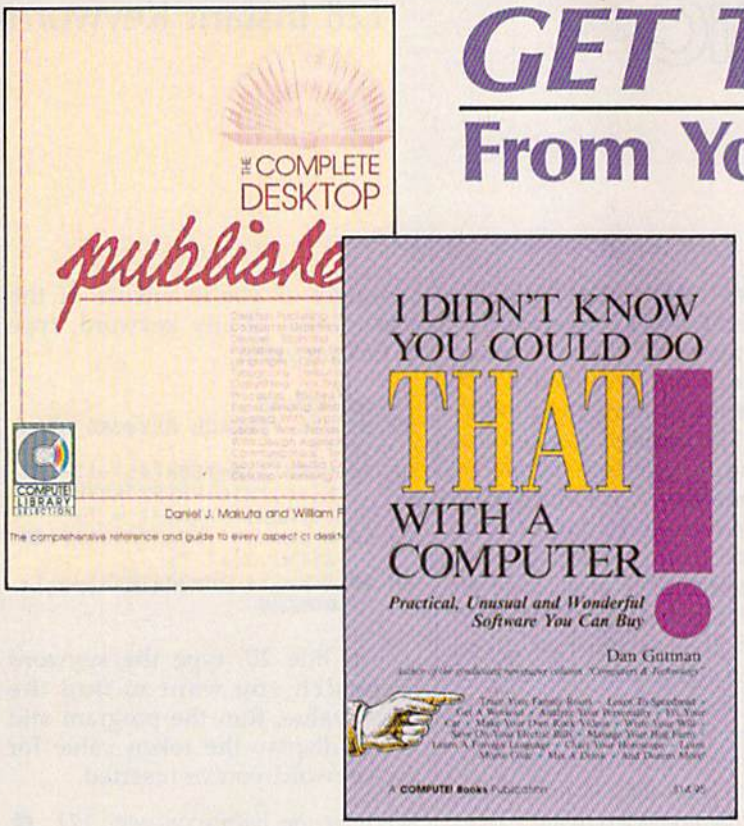
```
KP 100 FOR X=50 TO 150
QC 110 FILL 3,2,10+X,10,50+X,1
       0,30+X,50
AP 120 SWITCH:NEXT:LOWRES
```

Notice that the triangle moves off the screen without painting any unwanted areas. Fill-64 automatically clips the edge of any shape that moves across a screen border. It faithfully paints only the visible portion of a shape as long as its coordinates do not exceed the range −32768–32767.

See program listings on page 118.



These photos illustrate just a few of the thousands of hi-res graphics designs you can create with "Fill-64," a sophisticated graphics utility. Using new BASIC commands such as FILL, RECORD, and PLAY, you can draw animated graphics sequences, store the animation on disk or tape, and reload it for future viewing.



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128 Instant Keywords

Shawn K. Smith

Save time and typing effort with this short utility for the Commodore 128. Up to 52 keywords can be entered, each an easy-to-remember, two-key combination.

"Instant Keywords" can drastically reduce the time it takes to type in a program. This utility prints a BASIC 7.0 keyword when the Commodore or SHIFT key is pressed in conjunction with a letter key. For instance, pressing the SHIFT and L keys displays the keyword LOOP. A total of 52 keywords can be displayed in this fashion. Refer to the chart for a list of the key combinations. Also, pressing the SHIFT or Commodore key while in quote mode displays the standard graphics characters rather than a BASIC keyword.

Instant Keywords is short and easy to use. Although it contains mostly machine language (ML), you don't have to know any ML to use it. In fact, you can just type it in and run it as a BASIC program. First, type in the program and then save a copy. When you run it, the BASIC loader stores the ML in an area of RAM which is determined by the value S in line 100 (changing the value of S will relocate the utility). Once the data is stored in RAM, the utility is activated, the address to deactivate/reactivate it is displayed, and the loader is erased from memory. Pressing RUN/STOP and RESTORE is another way to deactivate the program.

Modifying The Program

Readers may wish to rearrange the utility to support a different set of keywords. This can be accomplished with minor changes to the utility. But first, a quick background about keywords is in order. BASIC 7.0 contains 130 plus commands or keywords. Most of the keywords (including all of the keywords in the 64's BASIC 2.0) are represented by one-byte tokens. For instance, the command PRINT is stored in the computer with a token value of $99 (153 decimal). Because the 128 has a larger vocabulary, the designers of the 128 decided to use two-byte tokens to represent some of the new commands. All of the new two-byte commands use $CE or $FE as the first byte of the token. Instant Keywords will allow you to use any keyword except those that begin with $CE as the first token value. (This eliminates the use of only eight keywords.)

The last 52 hexadecimal values in the loader (beginning with 0B in line 200) are the token values of the keywords displayed by Instant Keywords. The first 26 hex values are for the SHIFT key (the token for SHIFT-A is the first, and the token for SHIFT-Z is the twenty-sixth). The last 26 values are for the Commodore key. If you plan to add tokens for any two-byte commands, leave off the first byte ($FE)—the program knows that it is a two-byte command and will adjust itself accordingly. If you're unsure of the token value of any keyword, type in this program:

```
GA 10 GOTO30
EF 20 REM **PLACE KEYWORD HERE
      **
HS 30 BANK15:B=PEEK(45)+12+PEE
      K(46)*256:PRINT"KEYWORD
      {SPACE}VALUE(S) = ";
BD 40 H=PEEK(B):PRINTRIGHT$(HE
      X$(H),2);" ";
AE 50 IFH=254ORH=206THENB=B+1:
      GOTO40
```

In line 20, type the keyword for which you want to find the token value. Run the program and it will display the token value for the keyword you've inserted.

See program listing on page 121.

Letter	SHIFT	Commodore
A	SLEEP	STR$
B	BEGIN	BEND
C	CHR$	COLOR
D	DOPEN	DCLOSE
E	ELSE	ENVELOPE
F	FOR	FILTER
G	GOTO	GOSUB
H	HEX$	DEC
I	INPUT	INSTR
J	JOY	PLAY
K	DRAW	CHAR
L	LOOP	LOCATE
M	MID$	MOVSPR
N	NEXT	COLLISION
O	TAB(	SPC(
P	PRINT	PAINT
Q	GSHAPE	SSHAPE
R	RETURN	RESTORE
S	SPRITE	SOUND
T	THEN	TEMPO
U	USING	UNTIL
V	READ	DATA
W	WHILE	WINDOW
X	POKE	PEEK
Y	GRAPHIC	CIRCLE
Z	LEFT$	RIGHT$

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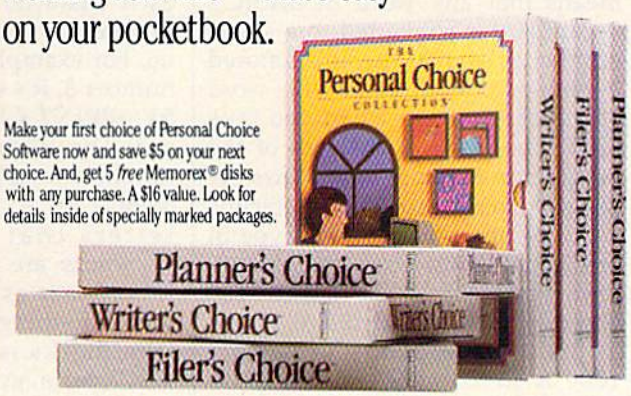

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BASIC Examiner

Rick Kephart

If you'd like to know how your Commodore 64 stores a BASIC program, this utility will help. It operates with any BASIC program and offers a complete analysis of its structure—exactly as it's seen by the computer.

What happens when you turn on your computer, type in a BASIC program, and run it? The Commodore 64 instantaneously performs a large number of complex tasks—so fast that you probably don't realize that your BASIC program undergoes a radical transformation after you type a line and press RETURN. This article and the accompanying program demonstrate just what happens.

Your BASIC program, as it's stored and run by your computer, looks quite different from what you may expect. First, any BASIC keywords (like FOR, NEXT, GOTO, and so on) are *tokenized*. This means that any word in BASIC's vocabulary is converted to a single number as soon as the line is stored in memory, rather than as the word you type in or see when you type LIST. This reduces the size of the program in memory and allows the program to run much more quickly.

The line numbers you type in are changed into a two-byte, binary form. For example, the number 100 is converted to 0 and 100 (0 × 256 + 100 = 100), and the number 1000 is stored as 3 and 232 (3 × 256 + 232 = 1000).

As each program line is placed into memory, a 0 is appended to the line to identify the end of that line. Three 0's are placed at the end of the program to indicate the last line.

Also added to the program are *line links*. These are two-byte numbers that point to the memory address where the next line begins. Everything in the Commodore 64 is stored at a particular memory location between 0 and 65535. Normally, a BASIC program is stored in memory (RAM—Random Access Memory) beginning with address 2049. The available RAM goes all the way up to address 40959. The program itself shares this space with all of its variables, arrays, and other odds and ends it requires as it runs.

Besides the items just discussed—the tokens, the tokenized line numbers, and the line links—each character that makes up the program is stored as an ASCII value. For example, if you type in the number 3, it's stored as the number 51—PRINT CHR$(51) will display a 3. The letter *A* is stored as the number 65—PRINT CHR$(65) will display an *A*. (But remember that letters that make up BASIC keywords are tokenized and will not appear as individual characters.) Anything typed within quotation marks is also stored in its ASCII form, even if it is a keyword.

For Disk And Tape Users

"BASIC Examiner," the program accompanying this article, demonstrates what we've discussed. It works with any BASIC program.

To get started, type in the program and save a copy to disk or tape. Disk users must also type in the following one-line program and save it as a separate file. (For example, save the main program as "BASIC EXAMINER" and the one-line program as "EXAMINER LOADER".)

```
10 POKE44,192:POKE56,208:PO
   KE49152,0:LOAD"BASIC EXA
   MINER",8
```

To use BASIC Examiner, load and run "EXAMINER LOADER" from disk. It will then automatically load BASIC Examiner. The loader program moves BASIC Examiner to another area in memory (address 49152), out of the way of the BASIC program which it will analyze (stored beginning at address 2049). This method allows a BASIC program of any length to be loaded into its normal location for viewing without disturbing the Examiner.

If you're using tape, first load the program you wish to examine just as you normally would, but do not run it. Then type the following two lines, pressing RETURN after each:

```
POKE 44,192: POKE 56,208: POKE
  49152,0: NEW
LOAD "BASIC EXAMINER",1
```

When the program prompts you for a filename, press RETURN.

Seeing It Work

When run, Examiner requests a program name. If you're using a disk drive, type in the name of any BASIC program on the disk in the drive. (You may wish to view the Examiner itself. If so, type BASIC EXAMINER.) The program then

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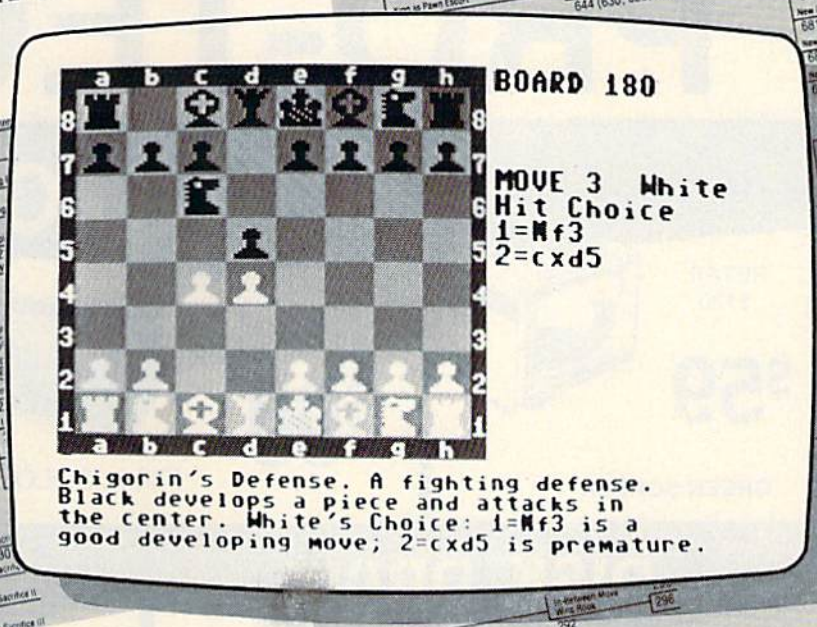
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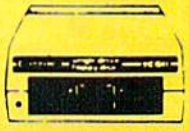

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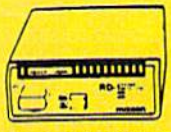

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asks for a line number at which to begin dissecting the program. Press RETURN to start at the beginning of the program. You don't have to choose a line number in the program. The Examiner will automatically jump to the next available line if the line number you enter is not in the program. If the number entered is higher than the highest line number in the program, the Examiner will start at the last line, indicate that it has found the end of the program, and ask for another line number. (Whenever the end of a program is reached, you're asked for a line number to restart the process.) As noted, pressing RETURN starts examining at the beginning of the program.

Every memory location used to store the program is displayed, one by one, in the following format:

- The memory location.
- The number stored in that memory location, displayed in both hexadecimal and decimal form. If the number represents a BASIC token or the end of a line, it is highlighted.
- If the number is not a BASIC token, the character-string form of the ASCII number is displayed.
- The BASIC token, or any especially significant ASCII value (one that clears the screen or changes a screen color, for example), is printed. Also, if a number is part of a line link or line number, that information is printed.

You may slow down the listing at any time by pressing the CTRL key. The listing may be paused by holding down SHIFT or SHIFT-LOCK. If you wish to view another part of the program, press and hold down RUN/STOP, then type in the new line number.

The top line of the screen retains the headings regardless of the rest of the screen's scrolling or clearing. A small machine language routine changes the interrupts to create the split screen. These interrupts are necessary for disk operations, and therefore the disk drive cannot be used while the split-screen is in operation. The RUN/STOP key is trapped in order to prevent any attempt to use the disk drive while the split screen is being displayed. Use the RUN/STOP-RESTORE combination to break out of the program. This, in turn, will restore the normal interrupt and make disk operations safe. *If a SYNTAX ERROR should stop the program while the headings are displayed across the top of the screen, do not attempt any disk operations until that line has been removed by pressing RUN/STOP-RESTORE.*

BASIC Examiner is written in BASIC, but includes a few machine language subroutines. Machine language is used to create the split screen and also, in the interest of space and time, to print out the BASIC tokens as keywords and to search for the location of the beginning line number requested.

See program listing on page 113.

Program Variables

A:	value of the Accumulator for the machine language subroutines
B:	flag to indicate if the value is a BASIC token
D:	used by the functions for decimal/binary/hexadecimal conversions
F:	length of the filename being loaded from the program
I and J:	used in loops and to read DATA
M:	memory location currently being examined
Q:	flag to indicate whether quote mode is on or off
S:	starting line number
V:	value stored in that memory location
X:	X-Register for machine language subroutines
Y:	Y-Register for machine language subroutines
V(0) and V(1):	two bytes of the line number or line link
D$:	character-string expression for DELete
F$:	filename to be loaded
I$:	string containing the introductory message
S$:	string form of the starting line number
Q$:	character-string expression for quotation marks
S$( ):	string array containing miscellaneous messages
FNC( ):	function to convert a decimal number 0–15 to a hexadecimal digit O–F
FNH( ) and FNL( ):	functions to convert a decimal number into high-byte/low-byte binary form

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Mastering 128 Sound And Music

Part 2

D. C. Holmes

Translating a melody from sheet music is easy with the 128's PLAY statement. This month the author describes and illustrates how this can be done with one-, two-, or three-voice compositions, and includes a Bach minuet.

Last month we discussed how the 128 has streamlined the music-programming process with the sound and music statements of BASIC 7.0. The key to this instant virtuosity is the PLAY statement. This month we'll see how we can translate sheet music into BASIC program lines using the PLAY statement.

The format for the PLAY statement is PLAY "V*n*, T*n*, O*n*, U*n*, X*n*, *elements, notes*". The capital letters represent characters you type; for the lowercase letters, substitute one of numbers or characters from the list below. Note that if you omit one of the control characters, the 128 uses the default value.

V*n* = Voice (*n*=1–3, default *n*=1)
T*n* = Tonal envelope (*n*=0–9, default *n*=0)
O*n* = Octave (*n*=0–6, default *n*=4)
U*n* = Volume (*n*=0–8, default *n*=9)
X*n* = Filter (*n*=1 for on, *n*=0 for off; default *n*=0)
Notes: C,D,E,F,G,A,B

Elements: #—sharp (♯)
$—flat (♭)
W—whole note (𝅝)
H—half note (𝅗𝅥)
Q—quarter note (♩)
I—eighth note (♪)
S—sixteenth note (𝅘𝅥𝅯)
.—dotted note
R—rest
M—wait for end of measure voice

For example, to play the first five notes of a C-major scale with voice 2 and volume 6, you would use **PLAY "V2 U6 CDEFG"** or you could use a string variable: **A$ = "V2 U6 CDEFG": PLAY A$** (the spaces are optional, but they make the string a little more readable).

The SID chip is capable of producing three independent voices (sounds) simultaneously. When the control character V*n* appears in a character string used in a PLAY statement, it specifies which one of the three voices is to be programmed by the characters which follow. The characters apply to that voice until another V*n* control character is found in the string. If no voice is specified, the default of V1 (voice #1) is assumed.

Tonal Envelope

The tonal quality of each of the voices used can be selected from one of ten envelopes. One of the 128's preset envelopes can be used (as we discussed last month), or you can create your own customized tonal envelope using the ENVELOPE and FILTER statements (we'll devote next month's installment to this). The control character T*n* specifies the envelope for the voice whose control character most recently preceded it. The SID will continue to be tuned to this envelope for this voice until this V*n* immediately preceeds another T*n*.

For example, take a look at line 70 of this month's program, "Minuet":

```
70 PLAY "V1 T7 V2 T0"
```

The SID is set to play voice 1 (V1) in envelope 7 (T7)—a piano sound—and voice 2 (V2) in envelope 0 (T0)—an organlike tone.

If no envelope is specified for a voice, that voice will use the default envelope of 0.

The semantics of the T*n* control character are somewhat different from the other control characters in the PLAY string. Whereas T*n* always refers to only the V*n* which most recently preceded it, the other control characters (O*n*, U*n*, X*n*) refer to the notes which follow, regardless of which voice is programmed to play them.

Octave

Notes may be programmed in a six-octave range, corresponding roughly to the middle 72 keys on the piano. The control character O*n* in a PLAY-statement character string dictates the octave range for all notes which follow, until another On control character is encountered. If no octave is specified, the default of O4 is assumed.

Volume

Dynamic level (volume) may be controlled by using the character U*n* in a PLAY string. The parameter *n* may range from 0 (no volume) to 9 (maximum volume), and it applies to all notes which follow in all voices until another U*n* character appears. You can't set individual volumes for the three voices, although changing the sustain values (with ENVELOPE) can make some sounds louder or softer than others. If U*n* does not appear in a program, the default value of U8 is used. Volume may also be specified using the VOL statement. The format is **VOL** *d* where *d* is a value from 0 (off) to 15 (maximum volume).

Notice that the range of volume settings, normally 0–15 when controlling volume with the VOL statement or with POKEs, is compressed in the U*n* control character to 0–9. Apparently the programmers who wrote the PLAY routine didn't want to have to deal with two-digit parameter settings (all the other PLAY control characters take only single-digit parameters). U0 corresponds to VOL 0, while U9 corresponds to VOL 15. Other volume settings are distributed roughly evenly between. For example, U4 corresponds to medium volume (the equivalent of VOL 7). The U*n* control character in a PLAY string allows more precise volume control than the VOL statement, but there are situations when it is more desirable to have volume control outside of a character string, using the VOL statement.

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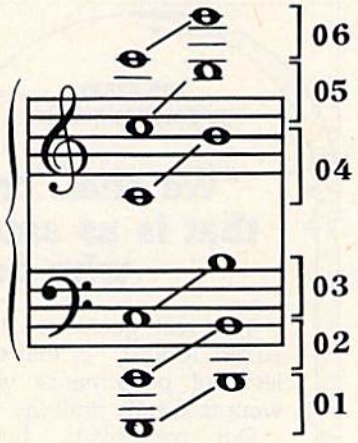
Filter

The X*n* control character allows additional creative control over the tonal quality of the 128's sound. X1 turns on the filter for a given voice and X0 turns it off. Within a composition, you may use the filter on one or more voices. The SID chip has only one filter, however, and it applies to all filtered voices at any one time.

Notes And Elements

To sound a note, place the letter of the note you want to play within the PLAY character string. Sharps and flats may be played by including the # (sharp) or $ (flat) element prior to the letter of the note. Octaves start at C and end at B, with middle C being O4 C.

The length of time the note is to be held is specified by preceding it with one of the duration elements (W,H,Q,I,S). When a dot (.) precedes a duration element, it increases the duration value of that element by half. For example, in



common time (4:4), the elements have these values:

S	(sixteenth note)	1/4 beat
I	(eighth note)	1/2 beat
.I	(dotted eighth note)	3/4 beat
Q	(quarter note)	1 beat
.Q	(dotted quarter note)	1-1/2 beats
H	(half note)	2 beats
.H	(dotted half note)	3 beats
W	(whole note)	4 beats
.W	(dotted whole note)	6 beats

A rest can be included in the PLAY character string by following a duration element with the R element (QR programs a quarter rest, SR a sixteenth rest, and so on).

The M element in a PLAY character string instructs the computer to wait for all voices currently playing to end the current measure.

With all of this in mind, we're now ready to begin writing music to PLAY on the Commodore 128. Let's start with the first measure in voice 1 of Bach's G Major Minuet. The first note is a quarter note D in octave 5 (O5QD). This is followed by eighth notes G, A, and B in octave 4 (O4IGIAIB) and eighth note C in octave 5 (O5IC). To play only the first measure of voice 1, type:

```
PLAY "V1 O5 QD O4 IG IA IB O5 IC"
```

Synchronizing voice 2 with voice 1 is a little trickier, though. Voice 2 begins with a half note G in octave 3 followed by a quarter note A in the same octave (O3HGQA). We want to program these notes in such a way that the half note G begins at the same moment as the quarter note D in voice 1, and the quarter note A is synchronized with the eighth note B in voice 1.

In order to understand the coordination of voices, let's consider the logical way the computer reads and plays the notes in a PLAY character string. When the 128 reads a note, it follows these two rules in determining when to start playing that note:

1. If the voice specified for this note is currently playing another note, the new note will begin after the old note has been played for the full duration specified. If this voice is not currently playing, the note begins immediately. (Remember that the voice is specified by the last V*n* character to precede a note in a PLAY string.)

2. The computer will not proceed to the next note in a string until the note just read has begun to be sounded (regardless of whether the notes are specified for the same, or different, voices).

So, we list the notes in the following order to play both voices in sync:

```
V2O3HG V1O5QD O4IG IA IB V2O3QA
  V1O5IC
```

This measure is programmed by the character string A$ in line 90 of the program "Minuet." I've found that the practice of assigning a name to a string in one line, and then PLAYing that string in another line, facilitates organization and debugging of my musical programs.

The notes of the second measure are listed in the same manner to synchronize their playing:

```
V1O5QD V2O3.HB V1O4IG IR IG IR
```

This string is named B$, the third measure C$, and so on.

Note that this melody was written in the key of G Major, and that there is one sharp (F#) in the key signature. The 128 doesn't know what key it's playing in, so any sharp or flat notes must be preceded by a # (sharp) or $ (flat) in the PLAY character string.

One more important note about synchronization: *The Commodore 128 System Guide* offers this advice (page 156) on synchronizing notes of different durations: "As a rule, always start with the note with the longer duration." This is a rule with which I disagree. If we followed this rule, we would come up with the following PLAY strings for the first six measures of "Minuet":

```
A$="V2O3HG V1O5QD O4IG IA
    V2O3QA V1O4IB O5IC"
B$="V2O3.HB V1O5QD O4IG IR IG IR"
C$="V2O4.HC V1O5QE IC ID IE I#F"
D$="V2O3.HB V1O5QG O4IG IR IG
    IR"
E$="V2O3.HA V1O5QC ID IC O4IB IA"
F$="V2O3.HG V1O4QB O5IC O4IB IA
    IG"
```

If you type these in and PLAY them, you'll find that the voices gradually lose their synchronization. By the end of the fifth measure, voice 2 is an eighth note ahead of voice 1. The explanation for this is fairly simple: There is a very small, but definite, period of time required for the computer to read and process each note. While a whole note should play for exactly the same duration as two half notes, the two half notes will take slightly longer to play on the 128 than the whole note because there are two notes to read and process instead of one. Four quarter notes, then, take longer to play than two half notes; eight eighth notes longer yet; and sixteen sixteenth notes even longer.

To overcome this inherent problem with the PLAY statement, I have my own rule for synchronization. To synchronize two or three notes to start playing at the same time, the notes should be listed in the following order in the PLAY character string:

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TEN COMMANDMENTS
#II
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1. List first the note played by the voice which is the last to stop playing prior to the point of synchronization. If more than one voice is currently playing, this voice will be the one which was last named in a PLAY character string.

2. List second the note played by the voice which is next to last to stop playing prior to the point of synchronization.

You can see how I've followed this rule in lines 100–160 in Minuet. Strings B$, C$, D$, E$, and F$ all begin with voice 1 since voice 1 was playing the last note specified in each preceding string.

Once these few concepts are understood, the listing of character strings for the rest of the piece is fairly straightforward. Although Minuet uses only two voices, the principles of listing and synchronization are the same for musical arrangements using all three voices. Next month, we'll explore the ENVELOPE statement and its parameters in more detail. We'll see how to use this statement for creative control of the SID's tonal quality.

See program listing on page 115.

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64 Multitasker

Richard F. and Sally J. Daley

Many powerful computers—such as the Amiga—have an advantage over the Commodore 64: They're capable of multitasking, running two or more programs at the same time. Here's a way to give your 64 the same capability.

The April 1985 issue of the GAZETTE included a program which partitioned the memory of the Commodore 64 into three individual 12K blocks. "Triple 64" allowed you to treat each block of memory as an independent computer. Each block could contain an independent program with its own variables. Now, "64 Multitasker" takes this idea one step further and lets you run two programs simultaneously.

Installing The Program

Since 64 Multitasker is written entirely in machine language, it must be entered using the "MLX" machine language entry program found elsewhere in this issue. Be sure you read the instructions for using MLX before you begin entering the data for Multitasker. When you run MLX, you'll be asked for the starting and ending addresses for the data you'll be entering. The correct values for Multitasker are as follows:

Starting address: C000
Ending address: C30F

When you've finished entering all the data, be sure to save a copy before leaving MLX.

To use Multitasker, load the program with a statement of the form LOAD "MULTITASKER",8,1. (Substitute the name you used when you saved the program. Tape users should substitute ,1,1 for the ,8,1.) Activate 64 Multitasker by typing SYS 49152. After a brief delay, the computer will respond with a READY prompt. Now press the f1 function key. You won't see anything happen yet (except possibly a blink of the cursor). Now type SYS 49155 and press RETURN. This time the screen will clear and the message MULTITASKER ENABLED will appear on the second line of the screen.

The memory is now configured into two separate and independent blocks—effectively two computers—ready for your use. At this point, you're in block 2. To confirm this, press f7. This key tells you which of the two blocks of memory is currently selected.

Blocks 1 and 2 each have 17917 bytes of memory available—you can check this by typing PRINT FRE(0). Now press f3, and you'll instantly switch to block 1. (This was the block you were in before the last SYS command.) Pressing f3 switches you from one block to the other.

Do not, under any circumstances, use the RUN/STOP and RESTORE sequence while using 64 Multitasker. It could cause the computer to lock up.

A Simple Test

If you've followed the procedure described above, you're now in block 1. If you're in block 2, press f3 to go back to block 1. If you're not sure which block you're in, press f7 to find out. Once in block 1, type in the following program:

```
100 FOR I=0 TO 10000
110 PRINT I
120 NEXT I
```

When you're finished, press f3 to switch to block 2 and type in this program:

```
100 FOR I=10000 TO 0 STEP -1
110 PRINT ,I
120 NEXT I
```

You can see that both programs are in memory at once by pressing f3 to switch between memory blocks and then typing LIST in each block.

Now go to block 1. Type RUN and press RETURN. You'll see a column of numbers at the left side of the screen counting up from zero. Watch it for a few seconds; then press f3 to get to block 2. Type RUN and press RETURN. You'll see a column of numbers counting down from 10,000. Because of the comma in the PRINT statement, the column is about one-fourth the way across the screen. This lets you easily differentiate between the two

blocks. Watch the programs run for a few seconds.

Press f3. You'll again see the program in block 1 running. Although pressing f3 allows you to switch between viewing the two programs running, the 64 still isn't really multitasking—if you watch carefully as you switch between the blocks, you can see that each program runs only while you view it. However, the more quickly you press f3, the closer you come to true multitasking.

Even Closer

You don't have to keep pressing f3 to make your 64 a multitasking computer. Pressing f5 makes the computer quickly swap tasks back and forth by itself. You may notice that the counting slows down to about half its previous speed. Your Commodore 64 is now running two programs, even though you can see only one screen at a time. You can check this by pressing f3 to swap screens.

The f5 key starts and stops the automatic functioning of the two blocks of memory as two independent computers. When you start multitasking, the program automatically switches between the two blocks, running both programs simultaneously. This switching occurs every three system interrupts, or 20 times per second.

The accompanying table is a guide for using the function keys. It also includes a number which can be POKEd into location 725 to simulate the pressing of a function key. You'll find this useful if you write programs to run under 64 Multitasker.

Function Key	POKE	Action
f1	4	Saves the contents of memory locations 0–1023 (needed only during installation)
f3	5	Switches between blocks in single process mode and between screens in multitasking mode
f5	6	Toggles the multitasking mode on and off
f7	3	Tells you which block is currently in use

Applications

You may already have some ideas for using the 64 Multitasker. If not, here are a few suggestions to get you started.

Background processing is an exciting possibility. For example, if you have a long sort to run, set it up and run the sort in one block; then swap blocks and do something else in the other block. You could write or edit a program, play a game, list a program to the printer, or look at a disk file.

How about creating a new form of game? You and a friend could design competitive items, such as spacecraft; then, using multitasking mode and sprites, you could let the two programs battle it out. The winner could be the program which destroys the creation of the other. Many variations on this theme are possible.

There are numerous possibilities for switching blocks under program control (remember, POKE 725,X—see the table). This can get complicated, but you could have a program in block 1 which would call a subroutine from block 2. The advantages are that you wouldn't have to worry about screen setup, variables, line numbers, or any of a number of other possible conflicts. Each block has its own screen, variables, and operating system memory from 0 to 1023.

Limitations

Unfortunately, 64 Multitasker does have some limitations. There are several items that are not separate for each block of memory. Most significant of these are the color memory and the I/O block. Also, if you set up a video effect, it affects both blocks. This is useful, however, in that sprites could be controlled from both blocks on one screen—an advantage for the two-program-game idea discussed above. Other items such as high-resolution graphics, programmable characters, and sound effects are also common to both blocks.

Another problem is the physical limitation of having only one screen, keyboard, serial port, and so on. If a program requires keyboard input as it is operating in the background, it must wait until you switch back into its block. An especially messy situation could occur if both programs tried to access the serial port at once.

64 Multitasker uses the function keys f1, f3, f5, and f7. If you wish to run a program that uses one or more of these function keys from within 64 Multitasker, you may have to change that program (f2, f4, f6, and f8 may be available). Another conflict arises when you try to run a program that uses memory beginning at location 49152 ($C000). This is the area where 64 Multitasker resides. Unfortunately, many other programs also are designed to be used at this location. In cases like this, it may be possible to relocate the code or data above location 49934, where 64 Multitasker ends.

Also remember that as long as two programs are running, each of them will run only at about half speed. This may affect some games.

How It Works

The principle of operation for 64 Multitasker is to exchange the operating system memory in pages 0–3 (locations 0–1023) during each system interrupt. These pages are transferred to a holding buffer. The two screens are maintained in different areas in memory, so they are not buffered—the video chip is simply set up to look at the user-selected screen. We chose not to exchange color memory because of the need also to exchange color registers in the video chip.

Moving the stack (page 1 of memory—locations 256–511) causes a few headaches. If you're new to machine language, the stack is a place designed to hold return addresses for subroutines and interrupts. If the stack or the stack pointer has been changed, an RTS instruction will not find the correct address on the stack. The CPU, unaware of the problem, will faithfully try to execute whatever instruction is found at the address located at the top of the stack. This usually results in a computer lock-up. The moral of the story is that the computer must copy the stack pointer and the stack whenever an exchange of system memory takes place.

See program listing on page 115.

1526 Underliner

Georg Zimmer

With this short machine language program, you can now have underlined characters on documents printed with the Commodore 1526 or MPS-802 printer. Written for the Commodore 64, it's fully compatible with SpeedScript *versions 2.0, 3.0, 3.1, and 3.2.*

SpeedScript is a powerful word processor, but it doesn't allow you to underline words or sentences when used with 1526 or MPS-802 printers. Now, with "1526 Underliner" you can do just that. Although Underliner is designed to work with *SpeedScript*, you can use it with any BASIC program or any program that doesn't disturb RAM locations 52809 to 53247.

Using Underliner With *SpeedScript*

First, you must modify *SpeedScript* so that it won't overwrite Underliner. To make a new copy with the underlining feature, load *SpeedScript*. If you're using *SpeedScript* 3.x, then type the following commands in direct mode:

```
POKE 2481,205
SAVE"UL.SPEED",8
```

If you're using *SpeedScript* 2.0, use these commands instead:

```
POKE 2370,164
POKE 2985,204
POKE 6547,204
SAVE"UL.SPEED",8
```

Now type in Underliner and save a copy on the same disk as your modified copy of *SpeedScript* (UL.SPEED). The next time you're ready to use *SpeedScript* with this feature, load and run Underliner instead. It will automatically load *SpeedScript* for you. Here's how to put Underliner into operation. A feature of *SpeedScript* known as *printkeys*—designed to let you use all of your printer's features—allows you to easily underline characters, words, or phrases. We'll use two of these printkeys. *SpeedScript 2.0* allows only the numbers 1—8 to be used as printkeys, but *SpeedScript 3.x* allows any character. First, we'll define a new underline character. To do this, go to the top of your document, press CTRL-£, and then press the key you wish to use for underlining (I use the minus key (—) for *SpeedScript 3.x*. Use 1 with *SpeedScript 2.0*). Then type "=255". Now define a reset character with a value of zero. To do this, press CTRL-£ again. Then press the key you wish to use (I use the 0 key for *SpeedScript 3.x*. Use 2 with *SpeedScript 2.0*) and type "=0". *SpeedScript 3.x* users should end up with something that looks like this:

```
■=255■=0←
Text goes here.←
Text . . . ■This will be underlined■.←
Text . . .←
■←
```

If you're using *SpeedScript 2.0*, you should see 1's instead of minus signs, and 2's instead of 0's.

To toggle underlining, press CTRL-£, and then the minus key (1 with *SpeedScript 2.0*). This is the same procedure normally used by *SpeedScript* to underline with non-Commodore printers. When you've finished typing, put the reset character at the bottom of your document. To do this, go to the end of your file with CTRL-Z. Then press CTRL-£, and then 0 (2 with *SpeedScript 2.0*). The reset character should now be the last character in your document.

It's always a good idea to print the document to screen before printing it on paper just to make sure everything is how you want it. Do this by pressing CTRL–SHIFT-P and selecting SCREEN at the prompt. If everything looks correct, then print your document with CTRL-P.

If you exit *SpeedScript*, Underliner is, of course, turned off. To reactivate it and reenter *SpeedScript*, type:

```
SYS 52809
RUN
```

Underliner also works with BASIC. Load Underliner and change line 120 to **SYS 52809** (delete everything after the SYS in the existing program). Run the program. Now use CHR$(255)—the pi sign—as the underline toggle. This can be done either in direct mode or within a program. To reset, print CHR$(0), or SYS 52809.

A Look Inside

Underliner is a small machine language subroutine that "patches" into the operating system (OS) of the 64. Whenever the OS wants to print a character, this subroutine takes control. It stores the characters it receives into a 255-byte buffer, then returns control to the OS, which sends the characters to the printer. When the OS tries to print a carriage return and linefeed, Underliner sends the carriage return only. It then scans the buffer for bytes of 255, which act as toggles for the underlining. If the underline toggle is on, it prints CHR$(164)—the underline character. If the toggle is off, it prints a space. Then it prints a linefeed, resets the buffer pointer, and returns control to the OS. Underliner repeats this process until the entire document has been printed.

See program listing on page 111.

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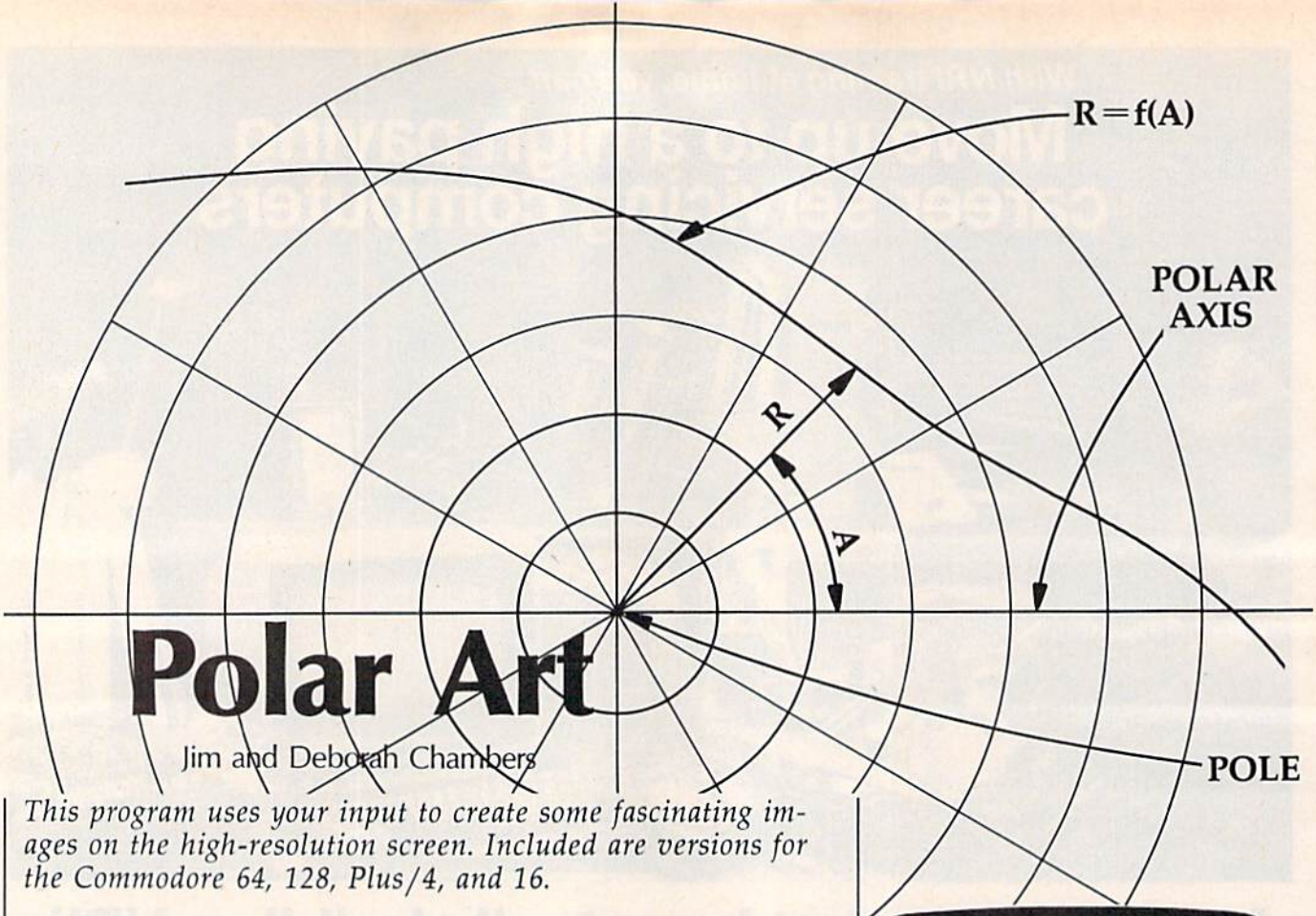
153-116



Polar Art

Jim and Deborah Chambers

This program uses your input to create some fascinating images on the high-resolution screen. Included are versions for the Commodore 64, 128, Plus/4, and 16.

As a matter of introduction, polar art is not what happens when you give a polar bear finger paints. It is, instead, a result of the beauty and elegance of mathematical equations of the form R=f(A), in which the points of a curve are described by a distance R (radius) from an origin or pole, and by an angle A (see figure above). This is different from the more familiar *x,y* method of graphing in the Cartesian coordinate system (named for René Descartes).

The advantage of polar graphing is that certain types of curves (such as circles, ellipses, and heart-shaped figures known as cardioids) are more easily described by using polar rather than Cartesian equations. The program that accompanies this article uses two different forms of polar equations and allows you to manipulate the constants. It then computes the coordinates of a number of points on the resulting curve and plots them on the hi-res screen. The result is polar art.

After typing in the program (Program 1 for the 64, Program 2 for the 128, Plus/4, and 16), save a copy. To use it, load it and type RUN. You're first asked to choose between two different drawing modes, Art I or Art II. Select one of these; then, when you're prompted for input, simply type in the required three or four constants (three for Art I, four for Art II). Separate these values by commas; then press RETURN. For starters, try the values shown below; then substitute some of your own. As written, the program will not allow invalid entries, so feel free to try fractions (like 0.1 or 1.5), negative numbers, and very large numbers (like 20,000).

Art I

N	R1	R2
1.5,	30,	60
3,	45,	78
3,	30,	60

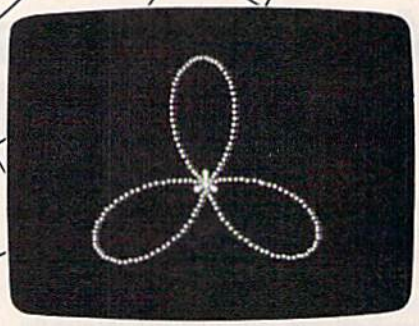
Art II

N1	N2	R1	R2
2,	8,	80,	16
2,	8,	40,	64

The Math Behind The Art

In Art I, the equation is R=R1+R2*SIN(N*A), where you choose the constants N, R1, and R2. In most cases, this equation generates circular curves and patterns.

In Art II, the equation is R=R1*SIN(N1*A)+R2*SIN(N2*A), where you set the constants N1, N2, R1, and R2. This equation can produce some very exotic curves.



This three-petal flower is typical of the attractive patterns produced with Art I. (Values used for this pattern are N=3, R1=50, R2=60.)

Art II's formula created this complex shell-like picture. (Values used for this pattern are N1=8, N2=1, R1=50, R2=60.)

Note that the greater the values for the constants, the longer it takes to plot the resulting curve.

See program listings on page 114.

Draw 128

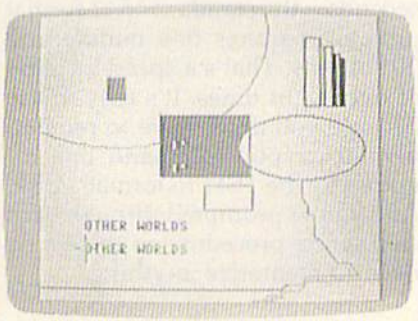
Mike Cortese

This short, easy-to-use 128 drawing program lets you sketch, draw circles, ovals, squares, and rectangles in any of 16 colors—and add text to your artwork. Also included is the ability to save and load your work. A joystick is required.

This program demonstrates how a compact program can be very useful with BASIC 7.0's powerful commands. "Draw 128" lets you create your own masterpieces with a few commands. The premise for the program is simple: With a joystick, you draw freely anywhere on the screen. By pressing any of the assigned keys (see below), you can create circles, ovals, rectangles, and boxes, and fill designated areas with color. You can choose to draw in any of the 128's available 16 colors. Also included is a command that lets you add text to your graphics screen. Additional commands allow you to save and load drawings for future use. Finished products can be used as title screens or pictures in your own BASIC programs. If you're not yet familiar with BASIC 7.0, you can study the program listing and see how to use some of these powerful commands.

An Empty Canvas

To get started, type in the program and save a copy to disk. Load the program, then plug a joystick into port 2 and run Draw 128. The crosshairs symbol appears at the center of an otherwise blank screen, and indicates the cursor position. You can toggle the cursor on and off by pressing the X key. Moving the joystick in any of the eight directions will result in moving the cursor and drawing a line if drawing mode is on (which it is when the program is first run). You can turn drawing mode on and off by pressing the D key. When the program is first run, it's in Fast mode—the cursor moves at a reasonable speed. If you want to draw in detail, you'll probably want to slow down the cursor speed. You can toggle fast mode on and off by pressing the F key. Also, when the program is first run, it's in Width 1 mode, which draws thin vertical lines. You can change these to double width (vertical lines only) by pressing W. Pressing W again turns off the double-width line.



This drawing program features hi-res graphics, text, and color.

You can change the drawing color by pressing the C key until the color you want is displayed. The border color changes to indicate the drawing color. All drawing is done in the color selected, including drawing ovals and rectangles and painting. Note that if you draw with more than two colors in the allotted 8 × 8-pixel area, the color breaks will appear blocky (like stairsteps in many cases) and won't look as you intended. This is due to the color limitations in graphic mode 1, which is used to allow for the most detail.

Rectangles, Squares, Ovals, and Circles

To draw a rectangle or square, move the cursor (which can be on or off—see above) to one of the four corners and press B. Then move the cursor to where you want the opposite corner and press B again. The rectangle or square will then be drawn in the current drawing color.

To draw a circle, move the cursor to the center of the area in which you want the circle drawn and press O. Then move the cursor left or right of the center (on exactly the same horizontal line) to the desired radius and press O twice. To draw an oval, move the cursor to the center of the oval to be drawn, press O, then move the cursor up or down (actually, any direction except due east or west) relative to the center and press O twice. Note that when drawing an oval, the second cursor position marks the maximum length and width of the oval, *but does not lie on its outer boundary.* It is suggested that you experiment with this feature before using it in any serious endeavor. The oval will be drawn in the current drawing color. This command can be used to make curves by having part of the oval drawn off the visible screen.

Fills And Text

To paint—or fill—an object, move the cursor in the area to be painted and press P. If the object is not completely closed, the color will leak out into the rest of the screen. To paint an area, it's best to draw with the double-width feature. There's less chance of color leaking.

To add text to your graphics screen, first select a color and then move the cursor to the position where you want the first letter to appear. Press T and the screen will clear. Then respond to the TEXT: prompt by typing your message. Press RETURN after typing the message, and the graphics screen will reappear with your text in place.

Pressing the E key erases the entire screen, moves the cursor to the middle of the screen, and sets the drawing color to black. The back arrow (←) key—in the upper left corner of the keyboard—places the cursor back in the center of the screen. After a screen is erased, it cannot be retrieved unless it was saved to disk.

The following keys move the cursor quickly to another part of the screen:

←	center
1	top left corner
2	top right corner
3	bottom left corner
4	bottom right corner

To save the graphics screen to disk, press S and type the filename. (Be sure the filename is unique, not one that already exists on your disk.) The screen will be saved and then displayed again.

To load a previously saved screen, press L and type the filename. It will automatically be loaded and the screen will be displayed. Then you can modify the screen and resave it if you wish. To view the disk directory, type D at the FILENAME: prompt.

To use a screen made with Draw 128 in a BASIC program, add these lines to the program:

```
BLOAD"filename", B0,P7168
GRAPHIC 1
```

To save a screen in program or immediate mode, use BSAVE *"filename"*,B0,P7168 TO P16383. This can be used to save any picture created in graphic mode 1.

See program listing on page 116.

Turbo Format

Ross Ouwinga

If you're interested in saving time, and wear and tear, on your 1541 disk drive, you'll put this program high on your list of utilities. It formats a disk in only 9-1/2 seconds—a super speed-up from the usual minute and 20 seconds—and it eliminates head knocking. Also, it's easy to use—just answer a few prompts, and you're seconds away from a formatted disk.

"Turbo Format" is a fast, easy-to-use disk formatting program. It formats a disk in only 9-1/2 seconds—the standard 1541 format program requires one minute and 20 seconds. That's a speed increase of over eight times. It's easy to use because you don't have to remember the cryptic command line required by the 1541 to format a disk. And you're prompted through each step of the procedure so there's no need to memorize anything.

Typing It In

The program is written entirely in machine language. "MLX," the machine language entry program found elsewhere in this issue, is required to type it in. After loading and running MLX, answer the prompts for starting and ending addresses with the following:

Starting address: 0801
Ending address: 0EC8

Type in Turbo Format and save it to disk. To run it, type LOAD *"filename"*,8 and RUN. There will be a short delay (while most of the program is transferred to the memory in the disk drive), and a title screen with the first prompt will be displayed.

Three Easy Steps

You're first prompted to enter the disk name (up to 16 characters). Virtually any character may be used in the name, but some may cause undesirable side effects, so caution is recommended whenever characters other than letters or numbers are used.

The second prompt is for the disk ID. This is the number used by the disk drive primarily to determine when a disk has been changed. Normally this number is two characters long, but Turbo Format will allow up to five characters.

More than five characters may be typed in, but only the first five will be used. Only the first two characters will actually be used by the disk drive to identify the disk after it has been formatted, but all five will appear in the BAM (Block Allocation Map).

Next, you'll be instructed to insert the disk to be formatted. *Be sure that you do not leave your disk with Turbo Format in the disk drive.* Formatting the disk will erase everything. A recommended safeguard is to put a write-protect tab on your disk immediately after you have a working copy. Turbo Format does check the write-protect tab, and if one is present, the disk will not be formatted. Also, an error message will appear to notify you that the disk is write protected.

Along with the prompt to insert a disk is an abort option. Press the f1 key to abort. This causes the program to start again at the beginning, prompting you to re-enter the disk name. This option allows you to change your mind and enter a new disk name or ID or correct any spelling errors before formatting the disk.

Two Kinds Of Formatting

The formatting process does not actually begin until you press the space bar or RETURN. Note, however, that the space bar and RETURN do not perform the same function. If you press the space bar, the disk will be formatted and all data written to the disk will be checked for errors. If an error occurs, the formatting will stop and the type of error will be displayed on the screen. If you press RETURN, the disk will be formatted as quickly as possible without checking for errors.

The reason for offering the two options is to allow you to use the program in a manner which most closely suits your needs. If the disks are verified, the procedure takes 17 seconds rather than 9-1/2 seconds. Verifying provides more assurance that the disk is formatted correctly. The additional 7 or 8 seconds may not make much difference to you. On the other hand, if speed is important, you may choose not to verify your disks. Errors occur very rarely and most are self-correcting, provided the disk itself is not damaged. Also, if you have a disk which you know is faulty, but wish to format anyway, you must use the no-verify option. I strongly recommend using the verify feature if you're formatting the back side of a disk certified only for single-side use, or if the disk is well used, or if you use an inexpensive, off-brand disk.

No Knock

After pressing the space bar or RETURN to format, the process begins. A feature that will be noticed immediately is that there is no loud knocking noise at the beginning of the format routine. A single short click is heard instead to indicate that the routine is working correctly. This feature is possible since Turbo Format is loaded from a disk at the start and the exact location of the read/write head is saved in memory in the disk drive. The program is then able to calculate the exact position of the first track without the excessive knock. The standard format routine does not necessarily know the position of the read/write head; it therefore assumes the worst-case condition and tries to step the head down 45 tracks. If the head reaches track one before it has stepped 45 times (which is usually the case), it bangs the head against the stop until the count of 45 is complete. It works, but it makes an awful racket and, in some cases, eventually works the disk drive out of alignment.

When the format process is complete, a message is displayed and will indicate OK if there were no errors. At this point you have the option of formatting another disk or quitting. It's important that you press f1 to quit. Do not reset the computer by turning it off and back on. The reason for this is that the format routine leaves the read/write head on track 35 when it finishes. By using f1 to quit, the disk drive is sent an initialize command and also a reset command to set everything back in order. If you accidentally turn the computer off, you should initialize the disk drive using the IO: command. Failure to do so could cause erratic operation. If you accidentally restarted when you intended to quit, it will be necessary to press RETURN for the enter name and ID prompts and press the space bar with no disk in the disk drive. An error will be detected immediately and you will again be given the prompt to quit by pressing f1.

Using Turbo Format does not mean your disks will become less reliable. It's much faster because it eliminates several very unnecessary and time-consuming routines. Most of the time used to format a disk is spent by a routine whose only function is to space the sectors evenly around the disk. Turbo Format sets this space the same for every sector on every track, but skips a time-consuming calculation process used in the standard formatting process. It's amazing how much time is saved by this one modification. To a lesser extent, time is saved by reducing delays when stepping between tracks and by eliminating unnecessary data-conversion routines. A technical discussion of this is beyond the scope of this article, but it should be noted that only those procedures that do not affect reliability were changed. Disks formatted with Turbo Format work just as well as those formatted the standard way.

Intermediate or advanced machine language programmers might be interested to know that the data recorded to the BAM of the disk is at locations $0B00 (2816) through $0BFF (3071). If you have a thorough understanding of the BAM and its contents, you can modify this area of the program to customize or personalize the BAM on your disks. Be aware, however, that modifying the BAM may have undesirable side effects and is not recommended for the beginner or someone who knows no more than the basics of disk drive operation.

For those of you with disk drives other than the 1541, Turbo Format will likely work if the drive claims to be 100-percent compatible. Most of the program is transferred to and operates in the disk drive and calls on several routines which are part of the standard program in the drive. If these routines are not at the same addresses as in the 1541, the program will not operate correctly. No damage will occur to your disk drive if this should happen, but it may be necessary to turn it off and on again to regain control.

See program listing on page 112.

simple answers to common questions

Tom R. Halfhill, Staff Editor

Each month, COMPUTE!'s GAZETTE *tackles some questions commonly asked by Commodore users. If you have a question you'd like to see answered here, send it to this column, c/o* COMPUTE!'s GAZETTE, *P.O. Box 5406, Greensboro, NC 27403.*

Q. With the VIC-20, you have approximately 3K of free BASIC memory. With the Commodore 64, you have 38K of free BASIC memory. What crazy arrangement kept the VIC-20 from having a lot of memory like the 64? As a result of this, shouldn't the VIC have some other special feature that the 64 doesn't have?

A. The "crazy arrangement" which limited the VIC-20 to 3K of BASIC memory was simply the state of computer technology in 1981, the year the VIC was introduced. You may not realize how dramatically computer technology has advanced and prices have dropped in the past five years.

Commodore's goal in 1981 was to bring out the first home computer with color graphics and sound for less than $300. At that time, the only other personal computers with color graphics were the Apple II (about $1,200 for 16K), the Atari 800 ($1,080 for 16K), the Atari 400 ($630 for 8K), the TRS-80 Color Computer (about $600 for 8K), and the Texas Instruments TI-99/4 (about $1,200 with 16K and color TV/monitor). None of those prices included a disk drive, tape drive, printer, or software. Floppy disk drives typically cost $500 to $800 during that period, and a dot-matrix printer with no special features cost $500 to $1,000. A 300-baud modem was around $300, not including interface. A 16K memory expansion board for the Atari 800 retailed for $200.

The VIC-20, introduced at $299, was a price breakthrough. It had 5K of RAM (3K free for BASIC), 16 colors, three-channel sound, built-in BASIC language, and a typewriter-style keyboard. It hooked up to a TV set and didn't require a special monitor, and for about $75 you could add a cassette recorder for loading and saving programs. The VIC was the opening shot in Commodore's home computer price war, and it played a major role in forcing down the prices of competitors.

This was before 64K RAM memory chips were affordable enough to be used in home computers. Instead, 16K RAM chips were the norm. A 16K RAM chip contains 16,384 bits of memory, so it actually takes eight of these chips to yield 16 kilobytes, which we commonly refer to as 16K. Even the IBM PC, introduced soon after the VIC-20, originally came with only 16K RAM. The VIC-20, at $299 for 5K, offered an attractive price/memory ratio of less than $60 per kilobyte. An 8K memory expander sold for about $80, or $10 per kilobyte.

By the summer of 1982, wholesale prices of the new 64K RAM chips had declined to the point where they became affordable for home computers. (Again, it takes eight 64K RAM chips to yield 64 kilobytes of memory.) For technical reasons, however, it was not practical to redesign the VIC-20 to accept the new chips. So Commodore introduced an entirely new computer—the Commodore 64. At its original retail price of $599, the 64 was another breakthrough. It offered a price/memory ratio of less than $10 per kilobyte. If the Commodore 64 had been constructed with the older 16K RAM chips, it would have taken 32 memory chips to yield 64 kilobytes. Not only would the cost have been prohibitive, but the computer would have been much larger and may have required a cooling fan.

After the 64 was introduced, the home computer price war really heated up and prices plunged. Today you can buy a Commodore 64 for less than $150, or a Commodore 128 with 128K of RAM for under $300 (less than $2.35 per kilobyte). Thanks to the new 256K RAM chips, which are replacing the 64K chips, prices are still dropping. The current price/memory champion is the Atari 1040ST, which comes with one megabyte of memory (1024K) for $999, including disk drive and monitor—less than $1 per kilobyte.

On the horizon are one-megabit RAM chips. It takes only eight of these to yield one megabyte, and they should be commonplace within two years.

Q. Is it possible to hook up both a TV and a monitor to a Commodore 64 at the same time? If so, can you show something different on each screen at the same time?

A. Yes and no. You can connect both a TV and a monitor simultaneously, but you can't show two different screens simultaneously. Both screens will show exactly the same thing.

To connect two screens to a 64, just plug a monitor into the composite output jack and a TV into the RF output jack. This capability comes in handy during group presentations, such as user group meetings and in classrooms. You could also hook up a monochrome monitor to the composite jack for text displays, and a TV to the RF jack for color graphics.

By the way, the Commodore 128 can also display two screens simultaneously—a 40-column display connected to the standard monitor or RF modulator (TV) output, and an 80-column display connected to the RGB output.

Something Fun For Teachers

Fred D'Ignazio
Associate Editor

For the last several months I've been conducting workshops to introduce teachers to computers, video, electronic keyboards, and other high-tech tools.

The workshops have been an exhilarating, eye-opening experience—for me as well as for the teachers. I've discovered that teachers are extremely interested in becoming competent with high-tech products, and they are enthused about introducing these products into the classroom. Over the last several months I have created a nucleus of highly motivated teachers who have returned to their schools and have started to build multimedia classrooms. The amount of energy and creativity these workshops have unleashed has been truly amazing.

At first, however, I made lots of mistakes. I kept experimenting and trying to do better. Gradually an approach emerged that has proven to be very successful. In the hope that hearing about this approach will benefit other workshop leaders, teacher trainers, and school administrators, I'd like to share some of the key elements with you.

Honesty

I've learned that the most effective way to reach teachers is to be absolutely honest. In this context, it means that I don't represent myself as a technology expert. Instead, I admit that I make mistakes and sometimes get confused about new machinery myself.

When I make mistakes in front of the teachers, I don't try to cover them up; instead I go out of my way to dramatize them and make them humorous. I leave lens caps on cameras, plug cables in the wrong way, and crash disks with great poise and aplomb. I've learned to look forward to making mistakes, since they usually turn into the funniest moments of each day's workshop.

Teachers Come First

I make the point early in each workshop that the equipment is not for kids; it's for the teachers. Teachers usually hear how computers and other high-tech materials are for kids, so no wonder they have little interest in the equipment and have little incentive to learn more about it themselves. If teachers see themselves as technicians or "facilitators" who deliver computer-based learning to students, they can't help feeling devalued and threatened.

Instead I stress that teachers come first and are central to the the personal development and growth of each student. In our workshops we look at things that computers can do that spark the interest of teachers and get them personally involved. I start every workshop by having all the teachers write me "Dear Fred" letters that tell me why they are really there and what they hope to get out of the workshop. I read their letters and let each teacher know I don't care about schools, principals, parents, or kids. All I care about is the teacher and his or her need to have a personally meaningful experience with me.

Quick Tech

I begin each workshop by picking up a huge stack of manuals. I tell the teachers that these are the manuals for the equipment that they see around them in the room. Then the manuals go into the wastebasket and the teachers are promised that they'll learn how to use all the equipment in two days *without reading about them.* There's usually applause at this point.

The message within all this melodrama is that manuals can be an extremely inefficient way for beginners to learn something new. I get the teachers to pressing buttons and pulling switches with great glee and playfulness, and suddenly the need for manuals goes away. Manuals come later when you have the self-confidence and the curiosity to learn how to do something specialized and can't figure it out on your own.

Fun

In the workshops, there are high-tech workstations all over—computers, video cameras, electronic synthesizers and digital samplers, amplifiers, TV monitors, VCRs, cassette recorders, and special-effects generators. But we avoid the word *workstation* in favor of *sandbox.* Each high-tech work area is a sandbox, and it's to be treated as such. You go there to play, be silly, be creative and imaginative, and have fun. You go there to lose your sense of time, and become oblivious to all the hubbub and confusion going on around you.

The approach works. I've had teachers take off their shoes and play synthesizers with their stockinged feet. Without embarrassment teachers climb onto tables and aim their video cameras at their classmates. They shoot irreverent close-ups of my ears, knees, and beard. They write haunted house stories on the computer and set them to music. They use *Print Shop* and create banners, personalized posters with their names and the graphics icon that they most identify with, and certificates that say, "Graduate of Fred's Multimedia Sandbox." A recent workshop ended with one teacher videotaping the rest of us holding up a banner that read, "All It Takes Is All You've Got!" Some of the teachers blew and popped bubbles. All of us danced together to Beethoven's Third Symphony. Who said learning about high-tech couldn't be fun?

Todd Heimarck
Assistant Editor

Programmers sometimes describe a subroutine or technique as being elegant. What is elegance? We might say that a short, simple, and fast program is more elegant than one that's long, complicated, and slow (although this isn't always true). It's almost an aesthetic judgment; a program that looks better and runs better is elegant.

Let's examine two techniques that are sometimes used in BASIC programs. In both cases, there's a better (more elegant) alternative.

A Page Of IF-THENs

You'll occasionally see a program with several lines that look something like this:

```
60 IF A = 5 THEN B = 7
70 IF A = 6 THEN B = 13
80 IF A = 7 THEN B = -3
90 IF A = 8 THEN B = 6
```

Let's say the value in variable A is an integer between 5 and 21; you'd need 17 IF-THENs to cover all possibilities. Not only do the 17 lines take up memory, but they also slow down the program. If the variable A happens to equal 19, the program has to go through several tests: Is A equal to 5? No. Is it 6? No. Is it 7? And so on.

The 17 lines of IF-THENs could be replaced by the following lines. First, put this at the beginning of the program:

```
10 DIM ZZ(17): FOR X = 1 TO 17: READ
   ZZ(X): NEXT
12 DATA 7,13,-3,6,...
```

The DATA statement would have to be filled in with the appropriate values, which are stored in the numeric array ZZ. Then, later in the program, where all the IF-THENs occur, a single line suffices:

```
60 B = ZZ(A-4)
```

Since the number in variable A is between 5 and 21, we subtract 4 to match it up with the array numbered from 1 to 17. The technique saves memory and noticeably improves the program speed.

Substituting A Period For Zero

In many cases, a period all by itself will act like a zero. Word has spread among Commodore programmers that a period is a good substitute. For obtaining random values, many programmers seem to prefer RND(.), which is said to be faster than RND(0) and more random than RND(1). We can test this with two programs. First we'll measure the speed of a period versus a zero:

```
EG 10 TI$="000000"
KM 20 FORJ=1TO1000:K=RND(.):NE
      XT:PRINT TI
SK 30 TI$="000000"
PS 40 FORJ=1TO1000:K=RND(0):NE
      XT:PRINT TI
JF 50 Z=0:TI$="000000"
KM 60 FORJ=1TO1000:K=RND(Z):NE
      XT:PRINT TI
```

On a 128 in 64 mode, the times were 174 jiffies (a jiffy is 1/60 second) when a period was used, 208 for a zero, and 186 for a variable equal to zero. A period is about 16 percent faster than a zero, which is quite an increase in speed. But if we substitute a variable equal to zero, the time saved is only about 6 percent. This example generates 1000 random numbers in roughly 180 jiffies, or 3/1000 second per random number. Six percent of .003 seconds doesn't amount to much, especially when you consider that getting a random number is only a small part of most programs.

Now let's see how the random numbers are created. The program below creates 5000 random numbers from 1 to 1000. A 1000-element array keeps track of how many times each is picked.

```
AM 10 S=0:R=0
GQ 20 DIM A(1000)
EC 30 FORJ=1TO5:PRINTJ,
BX 40 FORK=1TO1000:R=INT(RND(S
      )*1000+1):A(R)=A(R)+1
XQ 50 NEXTK,J:PRINT
CP 60 FORJ=1TO100:PRINTJ,A(J):
      NEXT
```

When S was zero, RND(S) gave these results: 90 was picked 16 times, 94 was picked 20 times, and 98 was picked 19 times (your results may vary slightly). The numbers 91, 92, 93, 95, 96, 97, 99, and 100 never appeared at all.

That's not the way a random number generator should work. RND(0) hits every fourth number (at least when you're asking for a number between 1 and 1000). It's like shaking dice 5000 times and seeing only twos and sixes. If you substitute S=1 in line 10, the distribution of random numbers improves greatly. RND(1) is clearly the better choice.

It's true that using a period yields a miniscule improvement in speed. But you should avoid RND(.) because of the problems associated with RND(0). Plus, it's confusing. Even if you understand that periods can replace zeros, RND(.) looks awkward and inelegant.

Professional Programmers

If you've been reading the GAZETTE for a few years, you might remember the "Inside View" section, where we published interviews with programmers. Fans of that column might enjoy a new book from Microsoft Press called *Programmers at Work*. It includes interviews with 19 well-known and successful microcomputer programmers. It's not an especially technical book, although it helps if you know a little about programming.

Two motifs that run through the book are elegance and simplicity. No two programmers define *elegance* the same way, but after you've read a few interviews, you start to get a pretty good notion of what it means.

Lots of books teach programming, but very few show you how programmers think. If you'd like to know more about how professional programmers do what they do, I recommend this book.

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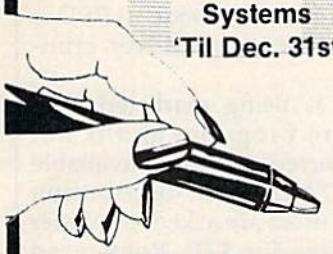
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User Group Update

When writing to a user group for information, please remember to enclose a self-addressed envelope with postage that is appropriate for the country to which you're writing.

Send typed additions, corrections, and deletions for this list to:

COMPUTE! Publications
P.O. Box 5406
Greensboro, NC 27403
Attn: Commodore User Groups

User Group Notes

The correct address for the **Rockland Area Commodore Users Group** is 354 East Water St., Rockland, MA 02370.

The Bristol Commodore Users Group now receives mail in care of Computech Systems, Inc., 178 Pine St., Bristol, CT 06010.

Fellsmere's Club Compu-Mania has a new address: P.O. Box 629, Fellsmere, FL 32948.

The VIC Indy Club has changed its name to the Indy Commodore Computer Club (IC3 or ICCC). The address is still P.O. Box 11543, Indianapolis, IN 46201.

The Osage/Kay Commodore User's Group (OKCOM) has changed its address to P.O. Box 1214, Ponca City, OK 74602.

The Commodore Computer Club has changed its address to P.O. Box 23396, Vancouver, BC, Canada V7B 1W1.

New Listings

CALIFORNIA

Commodore Users Group of Riverside (CUGR), P.O. Box 8085, Riverside, CA 92515

ILLINOIS

Meeting 64/128 Users Through the.Mail, 51 Thornhill Dr., Danville, IL 61832

MARYLAND

The Annapolis Commodore Users Group, P.O. Box 3358, Annapolis, MD 21403

MINNESOTA

Albert Lea Commodore Users Group, 2217 N. Bridge, Albert Lea, MN 56007

NEW YORK

Commodore Users of Western New York (CUWNY), 27 Oatka St., Warsaw, NY 14569

OHIO

The Commodore User Group, Inc. (TCUG), P.O. Box 63, Columbus, OH 43109

PENNSYLVANIA

Commodore 64/128 Club of Pittsburgh, 6337 Helen St., Library, PA 15129

Outside The U.S.

AUSTRALIA

Commodore User Group (ACT), P.O. Box 599, Belconnen, A.C.T., Australia 2616

CANADA

Sudbury Commodore Assembly Language Extension Group, 1326 Hastings Crescent, Sudbury, Ontario, Canada P3A 2R5

Commodore 64 Users Exchange (CUE), C.P. 1027, Malartic, Quebec, Canada J0Y 1Z0

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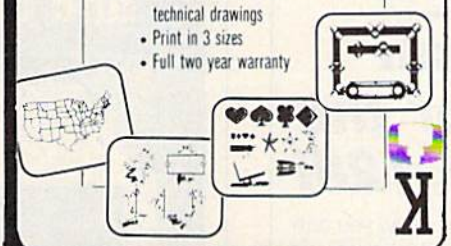
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All programs listed in this magazine are available on the GAZETTE Disk. See details elsewhere in this issue.

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Commodore Interface

The Deluxe RS-232 Interface from Omnitronix allows you to hook up standard RS-232 computer accessories such as modems, printers, robots, and more to the Commodore 64, 128, Plus 4, and VIC-20. The unit plugs into the user I/O port and supports RS-232 pins 2 through 8, 12, 20, and 22. The RS-232 interface supplies standard RS-232 plus and minus voltage levels, has switches located on the cover, and includes a three-foot cable. The instruction manual contains a BASIC terminal program.

The Deluxe RS-232 Interface has a suggested list price of $49.95.

Omnitronix, Inc., P.O. Box 43, Mercer Island, WA 98040.

Circle Reader Service Number 200.

Printer Driver Software For Commodore 64

The PPD is a software printer-driver program that provides complete software support to drive any Centronics compatible parallel printer through the 64's user port. Using the PPD program and an appropriate cable, any parallel printer can be accessed as though it were a standard Commodore serial printer. The software is compatible with much existing software.

PPD contains most selectable features found in other Commodore printer interfaces, including "PETSCII to ASCII" character conversion, a LISTing mode for BASIC programs, a transparent mode for high-resolution bit graphics, and automatic linefeeds after carriage returns. A feature unique to PPD is a built-in 8K interrupt-driven printer buffer.

PPD is being marketed as a Shareware program, and is not copy protected. It will be available through Shareware distribution channels; users are asked to register their copies for $10. Registered disks and cables may be purchased through Drude Micro Services; prices are $35 for disk and assembled cable; $25 for disk and unassembled cable; $30 for assembled cable only; and $20 for unassembled cable kit only.

Drude Micro Services, P.O. Box 533, Cedar Falls, IA 50613.

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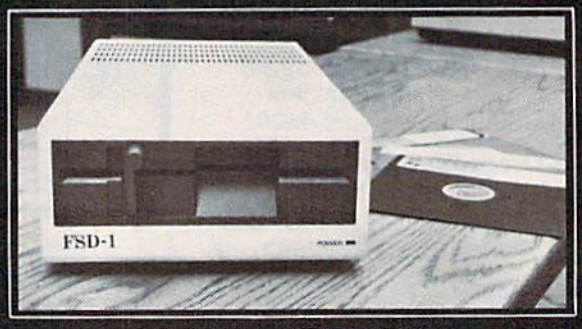

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How To Type In *COMPUTE!'s GAZETTE* Programs

Each month, COMPUTE!'s GAZETTE publishes programs for the Commodore 128, 64, Plus/4, 16, and VIC-20. Each program is clearly marked by title and version. Be sure to type in the correct version for your machine. All 64 programs run on the 128 in 64 mode. Be sure to read the instructions in the corresponding article. This can save time and eliminate any questions which might arise after you begin typing.

We frequently publish two programs designed to make typing easier: The Automatic Proofreader, and MLX, designed for entering machine language programs.

When entering a BASIC program, be especially careful with DATA statements as they are extremely sensitive to errors. A mistyped number in a DATA statement can cause your machine to "lock up" (you'll have no control over the computer). If this happens, the only recourse is to turn your computer off then back on, erasing whatever was in memory. So be sure to *save a copy of your program before you run it.* If your computer crashes, you can always reload the program and look for the error.

Special Characters

Most of the programs listed in each issue contain special control characters. To facilitate typing in any programs from the GAZETTE, use the following listing conventions.

The most common type of control characters in our listings appear as words within braces: {DOWN} means to press the cursor down key; {5 SPACES} means to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing another key), the character is underlined. For example, A means hold down the SHIFT key and press A. You may see strange characters on your screen, but that's to be expected. If you find a number followed by an underlined key enclosed in braces (for example, {8 A}), type the key as many times as indicated (in our example, enter eight SHIFTed A's).

If a key is enclosed in special brackets, [ ], hold down the Commodore key (at the lower left corner of the keyboard) and press the indicated character.

Rarely, you'll see a single letter of the alphabet enclosed in braces. This can be entered on the Commodore 64 by pressing the CTRL key while typing the letter in braces. For example, {A} means to press CTRL-A.

The Quote Mode

Although you can move the cursor around the screen with the CRSR keys, often a programmer will want to move the cursor under program control. This is seen in examples such as {LEFT} and {HOME} in the program listings. The only way the computer can tell the difference between direct and programmed cursor control is *the quote mode.*

Once you press the quote key, you're in quote mode. This mode can be confusing if you mistype a character and cursor left to change it. You'll see a reverse video character (a graphics symbol for cursor left). In this case, you can use the DELete key to back up and edit the line. Type another quote and you're out of quote mode. If things really get confusing, you can exit quote mode simply by pressing RETURN. Then just cursor up to the mistyped line and fix it.

When You Read:	Press:	See:
{CLR}	SHIFT + CLR/HOME	
{HOME}	CLR/HOME	
{UP}	SHIFT + ↑ CRSR ↓	
{DOWN}	↑ CRSR ↓	
{LEFT}	SHIFT + ← CRSR →	
{RIGHT}	← CRSR →	
{RVS}	CTRL + 9	
{OFF}	CTRL + 0	
{BLK}	CTRL + 1	
{WHT}	CTRL + 2	
{RED}	CTRL + 3	
{CYN}	CTRL + 4	

When You Read:	Press:	See:
{PUR}	CTRL + 5	
{GRN}	CTRL + 6	
{BLU}	CTRL + 7	
{YEL}	CTRL + 8	
{ F1 }	f1	
{ F2 }	SHIFT + f1	
{ F3 }	f3	
{ F4 }	SHIFT + f3	
{ F5 }	f5	
{ F6 }	SHIFT + f5	
{ F7 }	f7	
{ F8 }	SHIFT + f7	

When You Read:	Press:	See:
←	←	
↑	SHIFT + ↑	

For Commodore 64 Only

When You Read:	Press:	See:
[1]	COMMODORE + 1	
[2]	COMMODORE + 2	
[3]	COMMODORE + 3	
[4]	COMMODORE + 4	
[5]	COMMODORE + 5	
[6]	COMMODORE + 6	
[7]	COMMODORE + 7	
[8]	COMMODORE + 8	

The Automatic Proofreader

Philip I. Nelson, Assistant Editor

"The Automatic Proofreader" helps you type in program listings for the 128, 64, Plus/4, 16, and VIC-20 and prevents nearly every kind of typing mistake.

Type in the Proofreader *exactly* as listed. Since the program can't check itself, type carefully to avoid mistakes. Don't omit any lines, even if they contain unfamiliar commands. After finishing, save a copy or two on disk or tape before running it. This is important because the Proofreader erases the BASIC portion of itself when you run it, leaving only the machine language portion in memory.

Next, type RUN and press RETURN. After announcing which computer it's running on, the Proofreader displays the message "Proofreader Active". Now you're ready to type in a BASIC program.

Every time you finish typing a line and press RETURN, the Proofreader displays a two-letter checksum in the upper-left corner of the screen. Compare this result with the two-letter checksum printed to the left of the line in the program listing. If the letters match, it's almost certain the line was typed correctly. If the letters don't match, check for your mistake and correct the line.

The Proofreader ignores spaces not enclosed in quotes, so you can omit or add spaces between keywords and still see a matching checksum. However, since spaces inside quotes are almost always significant, the Proofreader pays attention to them. For example, **10 PRINT"THIS IS BASIC"** will generate a different checksum than **10 PRINT"THIS ISBA SIC"**.

A common typing error is transposition—typing two successive characters in the wrong order, like PIRNT instead of PRINT or 64378 instead of 64738. The Proofreader is sensitive to the *position* of each character within the line and thus catches transposition errors.

The Proofreader does *not* accept keyword abbreviations (for example, ? instead of PRINT). If you prefer to use abbreviations, you can still check the line by LISTing it after typing it in, moving the cursor back to the line, and pressing RETURN. LISTing the line substitutes the full keyword for the abbreviation and allows the Proofreader to work properly. The same technique works for rechecking programs you've already typed in.

If you're using the Proofreader on the Commodore 128, Plus/4, or 16, *do not perform any GRAPHIC commands while the Proofreader is active.* When you perform a command like GRAPHIC 1, the computer moves everything at the start of BASIC program space—including the Proofreader—to another memory area, causing the Proofreader to crash. The same thing happens if you *run* any program with a GRAPHIC command while the Proofreader is in memory.

Though the Proofreader doesn't interfere with other BASIC operations, it's a good idea to disable it before running another program. However, the Proofreader is purposely difficult to dislodge: It's not affected by tape or disk operations, or by pressing RUN/STOP– RESTORE. The simplest way to disable it is to turn the computer off then on. A gentler method is to SYS to the computer's built-in reset routine (SYS 65341 for the 128, 64738 for the 64, 65526 for the Plus/4 and 16, and 64802 for the VIC). These reset routines erase any program in memory, so be sure to save the program you're typing in before entering the SYS command.

If you own a Commodore 64, you may already have wondered whether the Proofreader works with other programming utilities like "MetaBASIC." The answer is generally yes, *if you're using a 64 and activate the Proofreader after installing the other utility.* For example, first load and activate MetaBASIC, then load and run the Proofreader.

When using the Proofreader with another utility, you should disable *both* programs before running a BASIC program. While the Proofreader seems unaffected by most utilities, there's no way to promise that it will work with any and every combination of utilities you might want to use. The more utilities activated, the more fragile the system becomes.

The New Automatic Proofreader

```
10 VEC=PEEK(772)+256*PEEK(773)
   :LO=43:HI=44
20 PRINT "AUTOMATIC PROOFREADE
   R FOR ";:IF VEC=42364 THEN
   {SPACE}PRINT "C-64"
30 IF VEC=50556 THEN PRINT "VI
   C-20"
40 IF VEC=35158 THEN GRAPHIC C
   LR:PRINT "PLUS/4 & 16"
50 IF VEC=17165 THEN LO=45:HI=
   46:GRAPHIC CLR:PRINT"128"
60 SA=(PEEK(LO)+256*PEEK(HI))+
   6:ADR=SA
70 FOR J=0 TO 166:READ BYT:POK
   E ADR,BYT:ADR=ADR+1:CHK=CHK
   +BYT:NEXT
80 IF CHK<>20570 THEN PRINT "*
   ERROR* CHECK TYPING IN DATA
    STATEMENTS":END
90 FOR J=1 TO 5:READ RF,LF,HF:
   RS=SA+RF:HB=INT(RS/256):LB=
   RS-(256*HB)
100 CHK=CHK+RF+LF+HF:POKE SA+L
   F,LB:POKE SA+HF,HB:NEXT
110 IF CHK<>22054 THEN PRINT "
   *ERROR* RELOAD PROGRAM AND
   {SPACE}CHECK FINAL LINE":EN
   D
120 POKE SA+149,PEEK(772):POKE
    SA+150,PEEK(773)
130 IF VEC=17165 THEN POKE SA+
   14,22:POKE SA+18,23:POKESA+
   29,224:POKESA+139,224
140 PRINT CHR$(147);CHR$(17);"
   PROOFREADER ACTIVE":SYS SA
150 POKE HI,PEEK(HI)+1:POKE (P
   EEK(LO)+256*PEEK(HI))-1,0:N
   EW
160 DATA 120,169,73,141,4,3,16
   9,3,141,5,3
170 DATA 88,96,165,20,133,167,
   165,21,133,168,169
180 DATA 0,141,0,255,162,31,18
   1,199,157,227,3
190 DATA 202,16,248,169,19,32,
   210,255,169,18,32
200 DATA 210,255,160,0,132,180
   ,132,176,136,230,180
210 DATA 200,185,0,2,240,46,20
   1,34,208,8,72
220 DATA 165,176,73,255,133,17
   6,104,72,201,32,208
230 DATA 7,165,176,208,3,104,2
   08,226,104,166,180
240 DATA 24,165,167,121,0,2,13
   3,167,165,168,105
250 DATA 0,133,168,202,208,239
   ,240,202,165,167,69
260 DATA 168,72,41,15,168,185,
   211,3,32,210,255
270 DATA 104,74,74,74,74,168,1
   85,211,3,32,210
280 DATA 255,162,31,189,227,3,
   149,199,202,16,248
290 DATA 169,146,32,210,255,76
   ,86,137,65,66,67
300 DATA 68,69,70,71,72,74,75,
   77,80,81,82,83,88
310 DATA 13,2,7,167,31,32,151,
   116,117,151,128,129,167,136
   ,137
```

MLX Machine Language Editor For The Commodore 64

Ottis Cowper
Technical Editor

"MLX" is a labor-saving utility that will help you enter machine language program listings without error. MLX is required to enter all Commodore 64 machine language programs published in COMPUTE!'s GAZETTE. This version of MLX was first published in the January 1986 issue; it cannot be used to enter MLX programs published prior to that date, nor can earlier versions of MLX be used to enter the listings in this issue.

Type in and save a copy of MLX. You'll need it for all future machine language programs in COMPUTE!'s GAZETTE, as well as machine language (ML) programs in our companion magazine, COMPUTE!, and COMPUTE! books. When you're ready to enter an ML program, load and run MLX. It asks you for a starting and ending address. These addresses appear in the article accompanying the MLX-format program listing you're typing. If you're unfamiliar with ML, the addresses (and all other values you enter in MLX) may appear strange. Instead of the usual decimal numbers you're accustomed to, these numbers are in *hexadecimal*—a base 16 numbering system commonly used by ML programmers. Hexadecimal—hex for short—includes the numerals 0–9 and the letters A–F. But even if you know nothing about ML or hex, you should have no trouble using MLX.

After you enter the starting and ending addresses, MLX offers the option of clearing the workspace. The data you enter with MLX is kept in a special reserved area of memory; clearing this workspace area fills the reserved area with zeros, which will make it easier to find where you left off typing if you enter the listing in several sessions. Choose this option if you're starting to enter a new listing. If you're continuing a listing that's partially typed from a previous session there's no point in clearing the workspace, since the data you load in will fill the area with whatever values were in workspace memory at the time of the last Save.

At this point, MLX presents a menu of commands:

Enter data
Display data
Load data
Save file
Quit

Press the corresponding key to select a menu option. These commands are available only while the menu is displayed. You can get back to the menu from most options by pressing RETURN.

Entering A Listing

To begin entering data, press E. You'll be asked for the address at which you wish to begin. (If you pressed E by mistake, you can return to the command menu by pressing RETURN.) When you begin typing a listing, enter the starting address here. If you're typing in a long listing in several sessions, you should enter the address where you left off typing at the end of the previous session. In any case, make sure the address you enter corresponds to the address of a line in the MLX listing. Otherwise, you'll be unable to enter the data correctly.

After you enter the address, you'll see that address appear as a prompt with a nonblinking cursor. Now you're ready to enter data. To help prevent typing mistakes, only a few keys are active, so you may have to unlearn some habits. MLX listings consist of nine columns of two-digit numbers—eight bytes of data and a checksum. You *do not* type spaces between the columns; the new MLX automatically inserts these for you. Nor do you press RETURN after typing the last number in a line; MLX automatically enters and checks the line after you type the last digit. The only keys needed for data entry are 0–9 and A–F. Pressing most of the other keys produces a warning buzz.

To correct typing mistakes before finishing a line, use the INST/DEL key to delete the character to the left of the cursor. (The cursor-left key also deletes.) If you mess up a line badly, press CLR/HOME to start the line over. The RETURN key is also active, but only *before* any data is typed on a line. Pressing RETURN at this point returns you to the command menu. After you type a character, MLX disables RETURN until the cursor returns to the start of a line. Remember, you can press CLR/HOME to quickly get to a line number prompt.

Beep Or Buzz?

After you type the last digit in a line, MLX calculates a checksum from the line number and the first eight columns of data, then compares it with the value in the ninth column. The formula (found in lines 370–390 of the MLX program) catches almost every conceivable typing error, including the transposition of numbers. If the values match, you'll hear a pleasant beep, the data is added to the workspace area, and the prompt for the next line of data appears (unless the line just entered was the last line of the listing—in which case you'll automatically advance to the Save option). But if MLX detects a typing error, you'll hear a low buzz and see an error message. Then MLX redisplays the line for editing.

To edit a line, move the cursor left and right using the cursor keys. (The INST/DEL key now works as an alternative cursor-left key.) You cannot move left beyond the first character in the line. If you try to move beyond the rightmost character, you'll reenter the line. To make corrections in a mistyped line, compare the line on the screen with the one printed in the listing, then move the cursor to the mistake and type the correct key. During editing, RETURN is active; pressing it tells MLX to recheck the line. You can press the CLR/HOME key to clear the entire line if you want to start from scratch, or if you want to get to a line number prompt to use RETURN to get back to the menu.

Other MLX Functions

The Display data option lets you review your work. When you select D, you'll be asked for a starting address. (As with the other menu options, pressing RETURN at this point takes you back to the command menu.) Make sure the address corresponds to a line from the listing. You can pause the scrolling display by pressing the space bar. (MLX finishes printing the current line before halting.) To resume scrolling, press the space bar again. The display continues to scroll until the ending address is reached, then the menu reappears. To break out of the display and return to the menu before the ending address is reached, press RETURN. A quick way to check your typing is to compare the reverse video checksums on the screen with the data in the rightmost column of the printed listing. If the values match, you can be sure the line is entered correctly.

The Save and Load menu options are straightforward. First, MLX asks for a filename. (Again, pressing RETURN at this prompt without entering anything returns you to the command menu.) Next, MLX asks you to press either T or D for tape or disk. If you notice the disk drive starting and stopping several times during a load or save,

don't panic; this behavior is normal because MLX opens and reads from or writes to the file instead of using the usual LOAD and SAVE commands. For disk, the drive prefix 0: is automatically added to the filename (line 750), so this should *not* be included when entering the name. (This also precludes the use of @ for Save-with-Replace, so remember to give each version saved a different name.) MLX saves the entire workspace area from the starting to ending address, so the save or load may take longer than you might expect if you've entered only a small amount of data from a long listing. When saving a partially completed listing, make sure to note the address where you stopped typing so you'll know where to resume entry when you reload.

MLX reports any errors detected during the save or load. (Tape users should bear in mind that the Commodore 64 is never able to detect errors when saving to tape.) MLX also has three special load error messages: INCORRECT STARTING ADDRESS, which means the file you're trying to load does not have the starting address you specified when you ran MLX; LOAD ENDED AT *address*, which means the file you're trying to load ends before the ending address you specified when you started MLX; and TRUNCATED AT ENDING ADDRESS, which means the file you're trying to load extends beyond the ending address you originally specified. If you get one of these messages and feel certain that you've loaded the right file, exit and rerun MLX, being careful to enter the correct ending address.

The Quit menu option has the obvious effect—it stops MLX and enters BASIC at a READY prompt. Since the RUN/STOP key is disabled, Q lets you exit the program without turning off the computer. (Of course, RUN/STOP-RESTORE also gets you out.) You'll be asked for verification; press Y to exit to BASIC, or any other key to return to the menu. After quitting, you can type RUN again and reenter MLX without losing your data, as long as you don't use the clear workspace option.

The Finished Product

When you've finished typing all the data for an ML program and saved your work, you're ready to see the results. The instructions for loading the finished product vary from program to program. Some ML programs are designed to be loaded and run like BASIC programs, so all you need to type is LOAD *"filename"*,8 for disk or LOAD *"filename"* for tape, and then RUN. (Such programs usually have 0801 as their MLX starting address.) Others must be reloaded to specific addresses with a command such as LOAD *"filename"*,8,1 for disk or LOAD *"filename"*,1,1 for tape, then started with a SYS to a particular memory address. (On the Commodore 64, the most common starting address for such programs is 49152, which corresponds to MLX address C000.) In any case, you should always refer to the article which accompanies the ML listing for information on loading and running the program.

By the time you finish typing in the data for a long ML program, you'll have several hours invested in the project. Don't take chances—use our "Automatic Proofreader" to type in MLX, and then test your copy *thoroughly* before first using it to enter any significant amount of data. (Incidentally, MLX is included every month on the GAZETTE DISK.) Make sure all the menu options work as they should. Enter fragments of the program starting at several different addresses, then use the Display option to verify that the data has been entered correctly. And be sure to test the Save and Load options several times to ensure that you can recall your work from disk or tape. Don't let a simple typing error in MLX cost you several nights of hard work.

MLX

For instructions on entering this listing, refer to "How To Type In COMPUTE!'s GAZETTE Programs" elsewhere in this issue.

```
EK 100 POKE 56,50:CLR:DIM IN$,
       I,J,A,B,A$,B$,A(7),N$
DM 110 C4=48:C6=16:C7=7:Z2=2:Z
       4=254:Z5=255:Z6=256:Z7=
       127
CJ 120 FA=PEEK(45)+Z6*PEEK(46)
       :BS=PEEK(55)+Z6*PEEK(56
       ):H$="0123456789ABCDEF"
SB 130 R$=CHR$(13):L$="{LEFT}"
       :S$=" ":D$=CHR$(20):Z$=
       CHR$(0):T$="{13 RIGHT}"
CQ 140 SD=54272:FOR I=SD TO SD
       +23:POKE I,0:NEXT:POKE
       {SPACE}SD+24,15:POKE 78
       8,52
FC 150 PRINT"{CLR}"CHR$(142)CH
       R$(8):POKE 53280,15:POK
       E 53281,15
EJ 160 PRINT T$" {RED}{RVS}
       {2 SPACES}§8 @3
       {2 SPACES}"SPC(28)"
       {2 SPACES}{OFF}{BLU} ML
       X II {RED}{RVS}
       {2 SPACES}"SPC(28)"
       {12 SPACES}{BLU}"
FR 170 PRINT"{3 DOWN}
       {3 SPACES}COMPUTE!'S MA
       CHINE LANGUAGE EDITOR
       {3 DOWN}"
JB 180 PRINT"{BLK}STARTING ADD
       RESS§43";:GOSUB300:SA=A
       D:GOSUB1040:IF F THEN18
       0
GF 190 PRINT"{BLK}{2 SPACES}EN
       DING ADDRESS§43";:GOSUB
       300:EA=AD:GOSUB1030:IF
       {SPACE}F THEN190
KR 200 INPUT"{3 DOWN}{BLK}CLEA
       R WORKSPACE [Y/N]§43";A
       $:IF LEFT$(A$,1)<>"Y"TH
       EN220
PG 210 PRINT"{2 DOWN}{BLU}WORK
       ING...";:FORI=BS TO BS+
       EA-SA+7:POKE I,0:NEXT:P
       RINT"DONE"
DR 220 PRINTTAB(10)"{2 DOWN}
       {BLK}{RVS} MLX COMMAND
       {SPACE}MENU {DOWN}§43":
       PRINT T$"{RVS}E{OFF}NTE
       R DATA"
ED 230 PRINT T$"{RVS}D{OFF}ISP
       LAY DATA":PRINT T$"
       {RVS}L{OFF}OAD DATA"
JS 240 PRINT T$"{RVS}S{OFF}AVE
        FILE":PRINT T$"{RVS}Q
       {OFF}UIT{2 DOWN}{BLK}"
JH 250 GET A$:IF A$=N$ THEN250
HK 260 A=0:FOR I=1 TO 5:IF A$=
       MID$("EDLSQ",I,1)THEN A
       =I:I=5
FD 270 NEXT:ON A GOTO420,610,6
       90,700,280:GOSUB1060:GO
       TO250
EJ 280 PRINT"{RVS} QUIT ":INPU
       T"{DOWN}§43ARE YOU SURE
        [Y/N]";A$:IF LEFT$(A$,
       1)<>"Y"THEN220
EM 290 POKE SD+24,0:END
JX 300 IN$=N$:AD=0:INPUTIN$:IF
       LEN(IN$)<>4THENRETURN
KF 310 B$=IN$:GOSUB320:AD=A:B$
       =MID$(IN$,3):GOSUB320:A
       D=AD*256+A:RETURN
PP 320 A=0:FOR J=1 TO 2:A$=MID
       $(B$,J,1):B=ASC(A$)-C4+
       (A$>"@")*C7:A=A*C6+B
JA 330 IF B<0 OR B>15 THEN AD=
       0:A=-1:J=2
GX 340 NEXT:RETURN
CH 350 B=INT(A/C6):PRINT MID$(
       H$,B+1,1);:B=A-B*C6:PRI
       NT MID$(H$,B+1,1);:RETU
       RN
RR 360 A=INT(AD/Z6):GOSUB350:A
       =AD-A*Z6:GOSUB350:PRINT
       ":";
BE 370 CK=INT(AD/Z6):CK=AD-Z4*
       CK+Z5*(CK>Z7):GOTO390
PX 380 CK=CK*Z2+Z5*(CK>Z7)+A
JC 390 CK=CK+Z5*(CK>Z5):RETURN
QS 400 PRINT"{DOWN}STARTING AT
       §43";:GOSUB300:IF IN$<>
       N$ THEN GOSUB1030:IF F
       {SPACE}THEN400
EX 410 RETURN
HD 420 PRINT"{RVS} ENTER DATA
       {SPACE}":GOSUB400:IF IN
       $=N$ THEN220
JK 430 OPEN3,3:PRINT
SK 440 POKE198,0:GOSUB360:IF F
        THEN PRINT IN$:PRINT"
       {UP}{5 RIGHT}";
GC 450 FOR I=0 TO 24 STEP 3:B$
       =S$:FOR J=1 TO 2:IF F T
       HEN B$=MID$(IN$,I+J,1)
HA 460 PRINT"{RVS}"B$L$;:IF I<
       24THEN PRINT"{OFF}";
HD 470 GET A$:IF A$=N$ THEN470
FK 480 IF(A$>"/"ANDA$<":")OR(A
       $>"@"ANDA$<"G")THEN540
MP 490 IF A$=R$ AND((I=0)AND(J
       =1)OR F)THEN PRINT B$;:
       J=2:NEXT:I=24:GOTO550
KC 500 IF A$="{HOME}" THEN PRI
       NT B$:J=2:NEXT:I=24:NEX
       T:F=0:GOTO440
MX 510 IF(A$="{RIGHT}")ANDF TH
       ENPRINT B$L$;:GOTO540
GK 520 IF A$<>L$ AND A$<>D$ OR
       ((I=0)AND(J=1))THEN GOS
```

```
      UB1060:GOTO470
HG 530 A$=L$+S$+L$:PRINT B$L$;
      :J=2-J:IF J THEN PRINT
      {SPACE}L$;:I=I-3
QS 540 PRINT A$;:NEXT J:PRINT
      {SPACE}S$;
PM 550 NEXT I:PRINT:PRINT"{UP}
      {5 RIGHT}";:INPUT#3,IN$
      :IF IN$=N$ THEN CLOSE3:
      GOTO220
QC 560 FOR I=1 TO 25 STEP3:B$=
      MID$(IN$,I):GOSUB320:IF
       I<25 THEN GOSUB380:A(I
      /3)=A
PK 570 NEXT:IF A<>CK THEN GOSU
      B1060:PRINT"{BLK}{RVS}
      {SPACE}ERROR: REENTER L
      INE [4]":F=1:GOTO440
HJ 580 GOSUB1080:B=BS+AD-SA:FO
      R I=0 TO 7:POKE B+I,A(I
      ):NEXT
QQ 590 AD=AD+8:IF AD>EA THEN C
      LOSE3:PRINT"{DOWN}{BLU}
      ** END OF ENTRY **{BLK}
      {2 DOWN}":GOTO700
GQ 600 F=0:GOTO440
QA 610 PRINT"{CLR}{DOWN}{RVS}
      {SPACE}DISPLAY DATA ":G
      OSUB400:IF IN$=N$ THEN2
      20
RJ 620 PRINT"{DOWN}{BLU}PRESS:
       {RVS}SPACE{OFF} TO PAU
      SE, {RVS}RETURN{OFF} TO
       BREAK[4]{DOWN}"
KS 630 GOSUB360:B=BS+AD-SA:FOR
      I=BTO B+7:A=PEEK(I):GOS
      UB350:GOSUB380:PRINT S$
      ;
CC 640 NEXT:PRINT"{RVS}";:A=CK
      :GOSUB350:PRINT
KH 650 F=1:AD=AD+8:IF AD>EA TH
      ENPRINT"{DOWN}{BLU}** E
      ND OF DATA **":GOTO220
KC 660 GET A$:IF A$=R$ THEN GO
      SUB1080:GOTO220
EQ 670 IF A$=S$ THEN F=F+1:GOS
      UB1080
AD 680 ONFGOTO630,660,630
CM 690 PRINT"{DOWN}{RVS} LOAD
      {SPACE}DATA ":OP=1:GOTO
      710
PC 700 PRINT"{DOWN}{RVS} SAVE
      {SPACE}FILE ":OP=0
RX 710 IN$=N$:INPUT"{DOWN}FILE
      NAME[4]";IN$:IF IN$=N$
      {SPACE}THEN220
PR 720 F=0:PRINT"{DOWN}{BLK}
      {RVS}T{OFF}APE OR {RVS}
      D{OFF}ISK: [4]";
FP 730 GET A$:IF A$="T"THEN PR
      INT"T{DOWN}":GOTO880
HQ 740 IF A$<>"D"THEN730
HH 750 PRINT"D{DOWN}":OPEN15,8
      ,15,"I0:":B=EA-SA:IN$="
      0:"+IN$:IF OP THEN810
SQ 760 OPEN 1,8,8,IN$+",P,W":G
      OSUB860:IF A THEN220
FJ 770 AH=INT(SA/256):AL=SA-(A
      H*256):PRINT#1,CHR$(AL)
      ;CHR$(AH);
PE 780 FOR I=0 TO B:PRINT#1,CH
      R$(PEEK(BS+I));:IF ST T
      HEN800
FC 790 NEXT:CLOSE1:CLOSE15:GOT
      O940
GS 800 GOSUB1060:PRINT"{DOWN}
      {BLK}ERROR DURING SAVE:
      [4]":GOSUB860:GOTO220
MA 810 OPEN 1,8,8,IN$+",P,R":G
      OSUB860:IF A THEN220
GE 820 GET#1,A$,B$:AD=ASC(A$+Z
      $)+256*ASC(B$+Z$):IF AD
      <>SA THEN F=1:GOTO850
KH 830 FOR I=0 TO B:GET#1,A$:P
      OKE BS+I,ASC(A$+Z$):IF
      {SPACE}ST AND(I<>B)THEN
       F=2:AD=I:I=B
FA 840 NEXT:IF ST<>64 THEN F=3
FQ 850 CLOSE1:CLOSE15:ON ABS(F
      >0)+1 GOTO960,970
SA 860 INPUT#15,A,A$:IF A THEN
       CLOSE1:CLOSE15:GOSUB10
      60:PRINT"{RVS}ERROR: "A
      $
GQ 870 RETURN
EJ 880 POKE183,PEEK(FA+2):POKE
      187,PEEK(FA+3):POKE188,
      PEEK(FA+4):IFOP=0THEN92
      0
HJ 890 SYS 63466:IF(PEEK(783)A
      ND1)THEN GOSUB1060:PRIN
      T"{DOWN}{RVS} FILE NOT
      {SPACE}FOUND ":GOTO690
CS 900 AD=PEEK(829)+256*PEEK(8
      30):IF AD<>SA THEN F=1:
      GOTO970
SC 910 A=PEEK(831)+256*PEEK(83
      2)-1:F=F-2*(A<EA)-3*(A>
      EA):AD=A-AD:GOTO930
KM 920 A=SA:B=EA+1:GOSUB1010:P
      OKE780,3:SYS 63338
JF 930 A=BS:B=BS+(EA-SA)+1:GOS
      UB1010:ON OP GOTO950:SY
      S 63591
AE 940 GOSUB1080:PRINT"{BLU}**
       SAVE COMPLETED **":GOT
      O220
AX 950 POKE147,0:SYS 63562:IF
      {SPACE}ST<>64 THEN970
FR 960 GOSUB1080:PRINT"{BLU}**
       LOAD COMPLETED **":GOT
      O220
DP 970 GOSUB1060:PRINT"{BLK}
      {RVS}ERROR DURING LOAD:
      {DOWN}[4]":ON F GOSUB98
      0,990,1000:GOTO220
PP 980 PRINT"INCORRECT STARTIN
      G ADDRESS (";:GOSUB360:
      PRINT")":RETURN
GR 990 PRINT"LOAD ENDED AT ";:
      AD=SA+AD:GOSUB360:PRINT
       D$:RETURN
FD 1000 PRINT"TRUNCATED AT END
       ING ADDRESS":RETURN
RX 1010 AH=INT(A/256):AL=A-(AH
      *256):POKE193,AL:POKE1
      94,AH
FF 1020 AH=INT(B/256):AL=B-(AH
      *256):POKE174,AL:POKE1
      75,AH:RETURN
FX 1030 IF AD<SA OR AD>EA THEN
      1050
HA 1040 IF(AD>511 AND AD<40960
      )OR(AD>49151 AND AD<53
      248)THEN GOSUB1080:F=0
      :RETURN
HC 1050 GOSUB1060:PRINT"{RVS}
      {SPACE}INVALID ADDRESS
       {DOWN}{BLK}":F=1:RETU
      RN
AR 1060 POKE SD+5,31:POKE SD+6
      ,208:POKE SD,240:POKE
      {SPACE}SD+1,4:POKE SD+
      4,33
DX 1070 FOR S=1 TO 100:NEXT:GO
      TO1090
PF 1080 POKE SD+5,8:POKE SD+6,
      240:POKE SD,0:POKE SD+
      1,90:POKE SD+4,17
AC 1090 FOR S=1 TO 100:NEXT:PO
      KE SD+4,0:POKE SD,0:PO
      KE SD+1,0:RETURN
```


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BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

1526 Underliner

(Article on page 96.)

```
GQ 100 PRINT"{CLR}{WHT}LOADING
        ML DATA":FORAD=52809TO
       52992:READML:POKEAD,ML
JP 110 SU=SU+ML:NEXT:IF SU <>
       {SPACE}22586 THEN PRINT
       "ERROR IN DATA":END
QG 120 SYS 52809:PRINT"LOADING
        SPEEDSCRIPT":LOAD"UL.S
       PEED",8
FK 130 DATA 173,251,206,208,12
       ,173,38,3,141,251,206,1
       73,39,3,141,252,206,169
JK 140 DATA 109,141,38,3,169,2
       06,141,39,3,169,0,133,5
       ,133,4,133,3,96,133,6
MD 150 DATA 152,72,138,72,165,
       6,208,6,32,100,206,76,2
       43,206,201,13,240,21
RD 160 DATA 164,5,153,1,207,20
       1,255,208,4,133,4,169,0
       ,32,250,206,230,5,76
FX 170 DATA 243,206,165,5,240,
       78,165,4,208,4,165,3,24
       0,70,198,5,164,5,185
KX 180 DATA 1,207,201,32,208,6
       ,198,5,16,243,48,53,230
       ,5,169,141,32,250,206
XF 190 DATA 160,0,185,1,207,20
       1,32,208,8,32,250,206,2
       00,197,5,208,241,166,3
HC 200 DATA 185,1,207,201,255,
       208,9,189,253,206,170,1
       33,3,76,227,206,189,255
HH 210 DATA 206,32,250,206,200
       ,196,5,208,227,169,13,3
       2,250,206,169,0,133,5
BD 220 DATA 133,4,104,170,104,
       168,165,6,96,76,0,0,1,0
       ,32,164
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Turbo Format

See instructions in article on page 100 before typing in.

```
0801:0D 08 0A 00 9E 28 32 30 05
0809:36 33 29 00 00 00 A9 16 8F
0811:85 FF A9 00 85 FB 85 FD 3E
0819:A9 0C 85 FC A9 05 85 FE EC
0821:20 89 09 20 51 09 A2 0B C5
0829:20 56 09 A0 00 20 5F 09 52
0831:A0 12 20 5F 09 A0 64 20 C3
0839:5F 09 A0 FF 20 CF FF C8 58
0841:C9 0D F0 0C C0 10 D0 03 43
0849:88 D0 F1 99 90 0B D0 EC E8
0851:C0 10 F0 08 A9 A0 99 90 F7
0859:0B C8 D0 F4 A0 73 20 5F FC
0861:09 A0 FF 20 CF FF C8 C9 F9
0869:0D F0 0C C0 05 D0 03 88 C3
0871:D0 F1 99 A2 0B D0 EC A9 E2
0879:96 8D A7 0B 20 77 09 A0 6F
0881:7F 20 5F 09 20 E4 FF C9 34
0889:00 F0 F9 C9 85 F0 60 C9 2C
0891:0D F0 1E C9 20 D0 ED 20 05
0899:A6 0E A9 A7 20 A8 FF A9 7D
08A1:04 20 A8 FF A9 01 20 A8 0B
08A9:FF A9 26 20 A8 FF 20 AE 1F
08B1:FF A0 46 20 5F 09 20 B5 C9
08B9:0E A0 02 B9 C4 0E 20 A8 1C
08C1:FF 88 10 F7 A9 00 20 A8 AB
08C9:FF A9 05 20 A8 FF 20 AE 1B
08D1:FF A5 BA 20 B4 FF A9 6F 0D
08D9:85 B9 20 96 FF 20 A5 FF 54
08E1:20 D2 FF C9 0D D0 F6 20 0D
08E9:AB FF A0 53 20 5F 09 A0 4A
08F1:C7 20 6B 09 20 E4 FF C9 4A
08F9:00 F0 F9 C9 85 F0 1E C9 18
0901:0D D0 F1 A9 A0 A0 15 99 F1
0909:90 0B 88 10 FA A0 04 A9 44
0911:41 99 A2 0B 88 A9 32 99 18
0919:A2 0B 4C 24 08 20 B5 0E 45
0921:A9 49 20 A8 FF A9 30 20 10
0929:A8 FF A9 3A 20 A8 FF 20 2C
0931:AE FF 20 B5 0E A9 55 20 DB
0939:A8 FF A9 3A 20 A8 FF A9 C5
0941:00 85 A2 A5 A2 C9 40 30 50
0949:FA 20 AE FF 20 E7 FF 60 B7
0951:A9 93 4C D2 FF A9 20 20 DA
0959:D2 FF CA D0 F8 60 B9 00 F7
0961:0A F0 06 20 D2 FF C8 D0 70
0969:F5 60 B9 00 09 F0 06 20 FD
0971:D2 FF C8 D0 F5 60 A9 08 9F
0979:85 FF A9 00 85 FB 85 FD A8
0981:A9 0B 85 FC A9 04 85 FE 13
0989:20 A6 0E A5 FD 20 A8 FF 33
0991:A5 FE 20 A8 FF A9 20 20 CB
0999:A8 FF A0 00 B1 FB 20 A8 7A
09A1:FF C8 C0 20 90 F6 A5 FB A7
09A9:69 1F 85 FB A5 FC 69 00 9C
09B1:85 FC A5 FD 69 20 85 FD 2F
09B9:A5 FE 69 00 85 FE 20 AE A2
09C1:FF C6 FF D0 C3 60 11 50 A4
09C9:52 45 53 53 20 12 52 45 29
09D1:54 55 52 4E 92 20 54 4F 9F
09D9:20 46 4F 52 4D 41 54 20 D4
09E1:41 4E 4F 54 48 45 52 20 73
09E9:44 49 53 4B 0D 50 52 45 23
09F1:53 53 20 12 46 31 92 20 E3
09F9:54 4F 20 51 55 49 54 11 AC
0A01:05 54 55 52 42 4F 20 46 52
0A09:4F 52 4D 41 54 20 92 0D 6C
0A11:00 11 46 4F 52 4D 41 54 C5
0A19:20 54 49 4D 45 20 49 53 E0
0A21:20 39 2E 35 20 53 45 43 C8
0A29:4F 4E 44 53 0D 31 37 20 F1
0A31:53 45 43 4F 4E 44 53 20 E7
0A39:57 49 54 48 20 56 45 52 91
0A41:49 46 59 0D 00 0D 46 4F 97
0A49:52 4D 41 54 54 49 4E 47 F2
0A51:0D 00 46 4F 52 4D 41 54 48
0A59:20 43 4F 4D 50 4C 45 54 9F
0A61:45 0D 00 0D 11 44 49 53 AB
0A69:4B 20 4E 41 4D 45 20 3F 08
0A71:20 00 0D 44 49 53 4B 20 C9
0A79:49 44 20 3F 20 00 0D 11 67
0A81:49 4E 53 45 52 54 20 44 F4
0A89:49 53 4B 0D 50 52 45 53 FA
0A91:53 20 12 46 31 92 20 54 66
0A99:4F 20 41 42 4F 52 54 0D 23
0AA1:50 52 45 53 53 20 12 52 E1
0AA9:45 54 55 52 4E 92 20 54 96
0AB1:4F 20 46 4F 52 4D 41 54 D1
0AB9:20 57 49 54 48 4F 55 54 A0
0AC1:20 56 45 52 49 46 59 0D 6C
0AC9:50 52 45 53 53 20 12 53 0B
0AD1:50 41 43 45 92 20 54 4F 28
0AD9:20 46 4F 52 4D 41 54 20 D6
0AE1:57 49 54 48 20 56 45 52 3A
0AE9:49 46 59 0D 0D 00 00 00 98
0AF1:00 00 00 00 00 00 00 00 06
0AF9:00 00 00 00 00 00 00 12 20
0B01:01 41 00 15 FF FF 1F 15 8C
0B09:FF FF 1F 15 FF FF 1F 15 A7
0B11:FF FF 1F 15 FF FF 1F 15 AF
0B19:FF FF 1F 15 FF FF 1F 15 B7
0B21:FF FF 1F 15 FF FF 1F 15 BF
0B29:FF FF 1F 15 FF FF 1F 15 C7
0B31:FF FF 1F 15 FF FF 1F 15 CF
0B39:FF FF 1F 15 FF FF 1F 15 D7
0B41:FF FF 1F 15 FF FF 1F 11 DB
0B49:FC FF 07 13 FF FF 07 13 11
0B51:FF FF 07 13 FF FF 07 13 9A
0B59:FF FF 07 13 FF FF 07 13 A2
0B61:FF FF 07 12 FF FF 03 12 91
0B69:FF FF 03 12 FF FF 03 12 19
0B71:FF FF 03 12 FF FF 03 12 21
0B79:FF FF 03 11 FF FF 01 11 14
0B81:FF FF 01 11 FF FF 01 11 DB
0B89:FF FF 01 11 FF FF 01 A0 73
0B91:A0 A0 A0 A0 A0 A0 A0 A0 A7
0B99:A0 A0 A0 A0 A0 A0 A0 A0 AF
0BA1:A0 A0 A0 A0 32 41 A0 A0 C6
0BA9:A0 A0 00 00 00 00 00 00 38
0BB1:00 00 00 00 00 00 00 00 C7
0BB9:00 00 00 00 00 00 00 00 CF
0BC1:00 00 00 00 00 00 00 00 D7
0BC9:00 00 00 00 00 00 00 00 DF
0BD1:00 00 00 00 00 00 00 00 E7
0BD9:00 00 00 00 00 00 00 00 EF
0BE1:00 00 00 00 00 00 00 00 F7
0BE9:00 00 00 00 00 00 00 00 FF
0BF1:00 00 00 00 00 00 00 00 08
0BF9:00 00 00 00 00 00 00 78 88
0C01:AD A2 04 85 12 AD A3 04 04
0C09:85 13 AD A7 04 8D FD 05 30
0C11:A9 A0 8D A7 04 AD 00 1C 45
0C19:09 0C 8D 00 1C 29 10 D0 E0
0C21:05 A9 A6 4C 0F 06 38 A5 66
0C29:22 69 01 85 4A 20 32 06 62
0C31:C6 4A D0 F9 A2 00 86 4B 66
0C39:20 39 06 A9 01 85 22 20 8D
0C41:4B F2 85 43 8A 0A 0A 0A 3B
0C49:0A 0A 85 44 AD 00 1C 29 AC
0C51:9F 05 44 8D 00 1C 20 53 DF
0C59:06 A9 55 8D 01 1C A0 00 1C
0C61:84 4D A5 39 99 00 03 C8 F2
0C69:C8 A5 4D 99 00 03 C8 A5 D5
0C71:22 99 00 03 C8 A5 13 99 CD
0C79:00 03 C8 A5 12 99 00 03 BF
0C81:C8 A9 0F 99 00 03 C8 99 1B
0C89:00 03 C8 B9 FA 02 59 FB A5
0C91:02 59 FC 02 59 FD 02 99 21
0C99:F9 02 E6 4D A5 4D C5 43 12
0CA1:90 C0 98 48 A9 00 85 30 52
0CA9:A9 03 85 31 20 30 FE 68 43
0CB1:A8 88 20 E5 FD 20 F5 FD FC
0CB9:A9 00 85 32 20 61 06 C6 D3
0CC1:4D D0 F9 50 FE B8 20 00 14
0CC9:FE A9 00 85 32 A5 22 C9 5A
0CD1:12 D0 28 A9 04 85 31 20 7F
0CD9:E9 F5 85 3A 20 8F F7 20 08
0CE1:FE 06 D0 2A A2 09 50 FE 90
0CE9:B8 CA D0 FA 20 53 06 20 55
0CF1:BB 06 20 C9 06 50 FE B8 32
0CF9:20 00 FE 20 26 07 D0 0E 01
0D01:E6 22 20 28 06 A5 22 C9 72
0D09:24 F0 05 4C 40 05 85 4B 43
0D11:AD 00 1C 29 F3 8D 00 1C 0A
0D19:A9 EC 8D 0C 1C A5 4B F0 B4
0D21:05 29 7F 4C C8 C1 60 20 EA
0D29:2B 06 AE 00 1C E8 4C 39 86
0D31:06 20 35 06 AE 00 1C CA D5
0D39:8A 29 03 85 44 AD 00 1C 90
0D41:29 FC 05 44 8D 00 1C A0 59
0D49:06 A2 00 CA D0 FD 88 D0 1C
0D51:FA 60 A9 CE 8D 0C 1C A9 A1
0D59:FF 8D 01 1C 8D 03 1C 60 C9
0D61:20 BB 06 A2 0A A4 32 50 FC
0D69:FE B8 B9 00 03 8D 01 1C D4
0D71:C8 CA D0 F3 A2 09 50 FE D4
0D79:B8 A9 55 8D 01 1C CA D0 BC
0D81:F5 20 BB 06 A0 04 50 FE 2B
0D89:B8 B9 9C 07 8D 01 1C 88 A3
0D91:10 F4 A2 40 A0 04 50 FE FD
0D99:B8 B9 A1 07 8D 01 1C 88 54
0DA1:10 F4 CA D0 EF A9 55 A2 DA
0DA9:08 50 FE B8 8D 01 1C CA BA
0DB1:D0 F7 A5 32 18 69 0A 85 0A
0DB9:32 60 A2 05 A9 FF 50 FE 96
0DC1:B8 8D 01 1C CA D0 F7 60 67
0DC9:A0 BB 50 FE B8 B9 00 01 CA
0DD1:8D 01 1C C8 D0 F4 50 FE FC
0DD9:B8 B9 00 04 8D 01 1C C8 70
0DE1:D0 F4 60 A9 D0 8D 05 18 27
0DE9:2C 05 18 10 0D 2C 00 1C 94
0DF1:30 F6 AD 01 1C B8 A0 00 AC
0DF9:98 60 A9 A1 60 A9 5A 85 AB
0E01:4B 20 E4 06 D0 17 A4 32 26
0E09:A2 0A 50 FE B8 AD 01 1C 8D
0E11:D9 00 03 D0 09 C8 CA D0 59
0E19:F1 A9 00 85 4B 60 C6 4B A5
0E21:D0 DF A9 A0 60 A5 43 85 82
0E29:4D A5 22 C9 12 D0 30 20 8A
0E31:FE 06 D0 63 20 B3 06 20 9A
0E39:E4 06 D0 5B A0 BB 50 FE AC
0E41:B8 AD 01 1C D9 00 01 D0 A8
0E49:4F C8 D0 F2 A2 FC 50 FE 31
0E51:B8 AD 01 1C D9 00 04 D0 BE
0E59:3F C8 CA D0 F1 F0 32 20 85
0E61:FE 06 D0 33 20 B3 06 20 C7
0E69:E4 06 D0 2B A0 04 50 FE FA
0E71:B8 AD 01 1C D9 9C 07 D0 57
0E79:1F 88 10 F2 A2 40 A0 04 D3
0E81:50 FE B8 AD 01 1C D9 A1 45
0E89:07 D0 0D 88 10 F2 CA D0 3A
0E91:ED C6 4D D0 CA A9 00 60 6A
0E99:A9 A5 60 4A 29 A5 D4 55 83
0EA1:4A 29 A5 94 52 20 B5 0E B7
0EA9:A0 02 B9 C1 0E 20 A8 FF 2C
0EB1:88 10 F7 60 A5 BA 20 B1 25
0EB9:FF A9 6F 85 B9 4C 93 FF AC
0EC1:57 2D 4D 45 2D 4D 00 00 71
```

Bump-N-Run

See instructions in article on page 44 before typing in.

```
C000:A9 00 8D 20 D0 8D 21 D0 D9
C008:8D 20 C7 8D 21 C7 AD 16 C3
C010:03 8D 18 03 AD 17 03 8D 07
C018:19 03 A9 16 8D 18 D0 A9 95
C020:80 8D 91 02 A9 93 20 D2 46
C028:FF A9 00 A2 80 9D 80 3F F8
C030:CA 10 FA A9 18 8D 99 3F 7E
C038:8D A2 3F A9 3C 8D 9C 3F 3C
C040:8D 9F 3F A2 33 BD 4C C6 72
C048:9D C4 3F CA 10 F7 20 1A 19
C050:C5 78 A9 05 8D 14 03 A9 C4
C058:C2 8D 15 03 58 20 80 C2 78
```

```
C060:A9 FF 8D 18 C7 A9 00 8D 5C
C068:15 C7 8D 16 C7 8D 17 C7 E3
C070:8D 1F C7 8D 19 C7 8D 1A 6F
C078:C7 A2 05 A9 00 9D 00 C7 FF
C080:9D 06 C7 A9 5A 9D 0C C7 0F
C088:CA 10 F0 AD 16 C7 29 03 91
C090:C9 03 D0 50 AD 15 C7 D0 F8
C098:48 AE 00 C7 AC 01 C7 AD 0D
C0A0:02 C7 8D 00 C7 AD 03 C7 89
C0A8:8D 01 C7 8E 02 C7 8C 03 5E
C0B0:C7 AD 17 C7 F0 1B C9 01 69
C0B8:F0 0D A9 01 8D 17 C7 A9 3D
C0C0:0B 8D 15 D0 4C D1 C0 A9 AF
C0C8:03 8D 17 C7 A9 13 8D 15 58
C0D0:D0 A2 03 BD 06 C7 9D 0C 36
C0D8:C7 CA 10 F7 A9 01 8D 15 F3
C0E0:C7 4C 2A C1 AD 17 C7 D0 E4
C0E8:18 AD 04 C7 CD 19 C7 D0 12
C0F0:0B AD 05 C7 CD 1A C7 D0 B7
C0F8:03 4C 01 C1 A9 FF 8D 18 CB
C100:C7 A9 00 8D 15 C7 AD 16 E3
C108:C7 2D 18 C7 29 07 C9 05 38
C110:D0 0A A9 01 8D 17 C7 A9 C5
C118:0B 8D 15 D0 C9 06 D0 0A 46
C120:A9 03 8D 17 C7 A9 13 8D F4
C128:15 D0 A2 00 8E 14 C7 A9 BC
C130:09 8D 12 C7 AD 01 DC 8D 13
C138:13 C7 20 DF C2 A2 02 8E 6C
C140:14 C7 A9 12 8D 12 C7 AD 08
C148:00 DC 8D 13 C7 20 DF C2 27
C150:A2 04 8E 14 C7 A9 24 8D F3
C158:12 C7 AD 04 C7 8D 19 C7 3B
C160:AD 05 C7 8D 1A C7 BD 0C 45
C168:C7 DD 06 C7 F0 06 DE 0C ED
C170:C7 4C 7E C1 A9 5A 9D 0C D4
C178:C7 A0 02 20 E4 C3 EE 14 72
C180:C7 AE 14 C7 BD 0C C7 DD 1E
C188:06 C7 F0 06 DE 0C C7 4C 82
C190:02 C2 A9 5A 9D 0C C7 A0 ED
C198:02 20 20 C4 AE 1F C7 F0 E7
C1A0:61 A9 00 8D 15 D0 FE 1F 21
C1A8:C7 A2 01 18 20 F0 FF AE CD
C1B0:1F C7 BD 1F C7 0A AA BD D8
C1B8:80 C6 20 D2 FF E8 BD 80 FE
C1C0:C6 20 D2 FF A2 64 A0 FF F1
C1C8:88 D0 FD CA D0 F8 AE 1F 18
C1D0:C7 BD 1F C7 C9 0F D0 27 5B
C1D8:A2 0C A0 10 18 20 F0 FF E8
C1E0:A2 2C 20 E3 C5 A2 0E A0 78
C1E8:0B 18 20 F0 FF A2 41 20 38
C1F0:E3 C5 AD 01 DC 0D 00 DC 95
C1F8:29 10 D0 F6 4C 00 C0 4C CE
C200:5D C0 4C 8B C0 AD 1E D0 70
C208:8D 16 C7 29 03 C9 03 D0 7B
C210:0E A2 00 20 22 C2 E8 20 55
C218:22 C2 A9 0F 8D 19 D0 4C 44
C220:31 EA BD 00 D0 DD 02 D0 83
C228:F0 55 10 2B DE 00 D0 DE A7
C230:06 D0 10 0C E0 01 F0 08 A4
C238:A9 F6 2D 10 D0 8D 10 D0 A4
C240:FE 02 D0 FE 08 D0 D0 37 2C
C248:E0 01 F0 33 A9 12 0D 10 8F
C250:D0 8D 10 D0 4C 7F C2 FE 95
C258:00 D0 FE 06 D0 D0 0C E0 15
C260:01 F0 08 A9 09 0D 10 D0 AB
C268:8D 10 D0 DE 02 D0 DE 08 D9
C270:D0 10 0C E0 01 F0 08 A9 77
C278:ED 2D 10 D0 8D 10 D0 60 FD
C280:A9 4A 8D 00 D0 8D 06 D0 B8
C288:A9 90 8D 01 D0 8D 03 D0 5C
C290:8D 05 D0 8D 07 D0 8D 09 B0
C298:D0 8D 0B D0 A9 0F 8D 02 FE
C2A0:D0 8D 08 D0 A9 AC 8D 0A 25
C2A8:D0 8D 04 D0 A9 12 8D 10 48
C2B0:D0 A9 FF 8D F8 07 8D F9 DA
C2B8:07 A9 FE 8D FA 07 8D FB EF
C2C0:07 8D FC 07 A9 04 8D 27 DC
C2C8:D0 A9 07 8D 28 D0 A9 01 B3
C2D0:8D 29 D0 8D 2A D0 8D 2B 35
C2D8:D0 A9 07 8D 15 D0 60 BD 55
C2E0:0C C7 DD 06 C7 F0 0C DE 73
C2E8:0C C7 4E 13 C7 4E 13 C7 C6
C2F0:4C 00 C3 A9 5A 9D 0C C7 D8
C2F8:20 AD C3 A0 00 20 E4 C3 8A
C300:EE 14 C7 AE 14 C7 BD 0C 2F
C308:C7 DD 06 C7 F0 0C DE 0C A9
C310:C7 4E 13 C7 4E 13 C7 4C 88
C318:27 C3 A9 5A 9D 0C C7 20 CB
C320:AD C3 A0 00 20 20 C4 AD 3C
C328:14 C7 4D 17 C7 D0 7D AE F1
C330:14 C7 4E 13 C7 B0 08 BD 7D
C338:1B C7 F0 0B 4C AC C3 A9 54
C340:00 9D 1B C7 4C AC C3 BD 69
C348:00 C7 8D 05 C7 BD 06 C7 CC
C350:8D 0B C7 BD FF C6 8D 04 70
C358:C7 BD 05 C7 8D 0A C7 A9 1E
C360:00 9D FF C6 9D 00 C7 9D D5
C368:05 C7 9D 06 C7 BD 00 D0 7E
C370:8D 05 D0 8D 0B D0 BD FF 0A
C378:CF 8D 04 D0 8D 0A D0 AD BC
C380:12 C7 2D 10 D0 F0 0B AD B7
C388:10 D0 09 24 8D 10 D0 4C 4A
C390:9A C3 AD 10 D0 29 DB 8D 7D
C398:10 D0 A9 07 8D 15 D0 A9 0E
C3A0:00 8D 17 C7 AD 12 C7 49 79
C3A8:FF 8D 18 C7 60 AC 14 C7 B8
C3B0:B9 00 C7 D0 05 A2 00 4C 1A
C3B8:C5 C3 29 80 F0 05 A2 01 23
C3C0:4C C5 C3 A2 02 BC F9 C5 3F
C3C8:4E 13 C7 B0 03 BC FC C5 0B
C3D0:4E 13 C7 B0 03 BC FF C5 19
C3D8:AE 14 C7 98 18 7D 00 C7 BD
C3E0:9D 00 C7 60 BD 00 C7 F0 A4
C3E8:33 29 80 F0 1A BD 01 D0 0E
C3F0:D9 02 C6 B0 06 20 0E C5 5C
C3F8:4C 1C C4 DE 01 D0 DE 07 44
C400:D0 20 EA C4 4C 1F C4 BD C9
C408:01 D0 C8 D9 02 C6 90 06 4F
C410:20 0E C5 4C 89 C4 FE 01 09
C418:D0 FE 07 D0 20 EA C4 60 4E
C420:BD 00 C7 F0 60 10 31 BD F3
C428:FF CF D9 06 C6 B0 13 AD 0E
C430:10 D0 2D 12 C7 D0 0B 20 74
C438:B4 C4 B0 06 20 0E C5 4C D4
C440:85 C4 DE FF CF DE 05 D0 6E
C448:10 3F AD 12 C7 49 FF 2D 11
C450:10 D0 8D 10 D0 4C 89 C4 58
C458:BD FF CF C8 D9 06 C6 90 4C
C460:13 AD 10 D0 2D 12 C7 F0 20
C468:0B 20 8D C4 B0 06 20 0E 69
C470:C5 4C 89 C4 FE FF CF FE 04
C478:05 D0 D0 09 AD 12 C7 0D B5
C480:10 D0 8D 10 D0 20 EA C4 9A
C488:60 20 EA C4 60 E0 05 D0 55
C490:57 AD 17 C7 D0 52 BD FF DB
C498:CF C9 36 10 06 20 DB C4 71
C4A0:4C B3 C4 C9 38 30 3F A9 1D
C4A8:9C 20 D2 FF A9 01 8D 1F 6E
C4B0:C7 A0 0A 60 E0 05 D0 30 7A
C4B8:AD 17 C7 D0 2B BD FF CF 05
C4C0:C9 24 30 06 20 DB C4 4C E4
C4C8:DA C4 C9 20 10 18 A9 9E FE
C4D0:20 D2 FF A9 02 8D 1F C7 06
C4D8:A0 23 60 AD 05 D0 C9 7B DC
C4E0:30 06 C9 A6 10 02 38 60 01
C4E8:18 60 BD 00 C7 30 0D C9 31
C4F0:52 30 05 A9 52 9D 00 C7 BB
C4F8:9D 06 C7 60 C9 AE 10 05 FF
C500:A9 AE 9D 00 C7 49 FF 9D C0
C508:06 C7 FE 06 C7 60 BD 00 04
C510:C7 49 FF 9D 00 C7 FE 00 C8
C518:C7 60 A9 81 20 D2 FF A2 DB
C520:00 A0 02 18 20 F0 FF A9 04
C528:B0 20 D2 FF A2 21 20 C7 10
C530:C5 A9 AE 20 D2 FF A2 02 BE
C538:20 F0 FF A9 ED 20 D2 FF 40
C540:A2 21 20 C7 C5 A9 BD 20 56
C548:D2 FF A2 01 C8 20 F0 FF 4A
C550:A2 0A 20 E3 C5 A2 01 A0 4D
C558:0F 20 F0 FF A2 21 20 E3 4F
C560:C5 A2 01 A0 1C 20 F0 FF E4
C568:A2 15 20 E3 C5 A9 99 20 F4
C570:D2 FF A2 03 A0 02 20 F0 28
C578:FF A9 B0 20 D2 FF A2 21 83
C580:20 C7 C5 A9 AE 20 D2 FF FC
C588:A2 16 20 F0 FF A9 AD 20 20
C590:D2 FF A2 21 20 C7 C5 A9 41
C598:BD 20 D2 FF A2 04 20 F0 BB
C5A0:FF A9 05 20 D0 C5 A2 10 2C
C5A8:20 F0 FF A9 05 20 D0 C5 2B
C5B0:A2 04 A0 25 20 F0 FF A9 63
C5B8:05 20 D0 C5 A2 10 20 F0 CB
C5C0:FF A9 05 20 D0 C5 60 A9 61
C5C8:C0 20 D2 FF CA 10 F8 60 FF
C5D0:8D 22 C7 A9 DD 20 D2 FF 54
C5D8:E8 18 20 F0 FF CE 22 C7 39
C5E0:10 F1 60 BC 0A C6 CA BD 87
C5E8:0A C6 20 D2 FF CA BD 0A 0D
C5F0:C6 20 D2 FF CA 88 D0 F6 53
C5F8:60 00 01 FF FF FF FE 01 D3
C600:02 01 4F D2 48 D9 2C 2D 15
C608:25 34 30 20 3A 65 6C 70 ED
C610:72 75 70 9C 09 30 20 3A 8F
C618:77 6F 6C 6C 65 79 9E 09 E8
C620:6E 75 72 2D 6E 2D 70 6D D9
C628:75 62 9F 0A 72 65 76 6F 23
C630:20 65 6D 61 67 9F 09 74 2B
C638:65 73 65 72 20 6F 74 20 F0
C640:65 72 69 66 20 73 73 65 CB
C648:72 70 9A 13 18 00 00 18 88
C650:00 00 00 18 00 00 18 00 41
C658:3C 00 00 66 00 00 C3 00 F1
C660:01 81 80 3F 00 FC 3F 00 45
C668:FC 01 81 80 00 C3 00 00 FB
C670:66 00 00 3C 00 00 18 00 25
C678:00 18 00 00 18 00 00 18 E4
C680:A0 30 A0 31 A0 32 A0 33 D3
C688:A0 34 A0 35 A0 36 A0 37 31
C690:A0 38 A0 39 31 30 31 31 02
C698:31 32 31 33 31 34 31 35 96
C6A0:00 00 00 00 00 00 00 00 2E
```

BASIC Examiner

(Article on page 84.)

```
GR 100 IFPEEK(46)<PEEK(44)THEN
       POKE45,PEEK(174):POKE46
       ,PEEK(175):CLR
QK 110 GOSUB360:SYS844:POKE808
       ,239:PRINT"{CLR}"
KG 120 POKE648,160:PRINT"
       {HOME}{RVS}LOCATION BHEX
       BDECIMALBMEANING
       {12 SPACES}":POKE648,4
EA 130 D=256:POKEA,FNH(S):POKE
       X,FNL(S):SYS828:M=PEEK(
       A)+D*PEEK(X):D=16:PRINT
HD 140 FORI=33TO34:V(0)=PEEK(M
       ):V(1)=PEEK(M+1):IFV(0)
       +V(1)=0THENNEXT:GOTO330
RM 150 FORJ=0TO1:V=V(J):PRINTM
       +JTAB(9);
KJ 160 PRINTTAB(9)CHR$(FNC(FNH
       (V)))CHR$(FNC(FNL(V)))T
       AB(14)V(J);:IFJ=0THENPR
       INT
XE 170 NEXT:M=M+2:PRINTTAB(21)
       S$(I)V(0)+256*V(1):PRIN
       T:NEXT:M=M-1
JJ 180 M=M+1:V=PEEK(M):WAIT653
       ,1,1:IFPEEK(203)=63THEN
       350
KS 190 B=(V>127ANDV<204ORV=255
       )ANDNOTQ:IFVTHEN210
KE 200 PRINTMTAB(9)"{RVS}00"TA
       B(15)"0{OFF}"TAB(21)"
       {RVS}END-OF-LINE{DOWN}"
       :M=M+1:Q=V:GOTO140
SM 210 PRINTMTAB(9)CHR$(18*-B)
       CHR$(FNC(FNH(V)))CHR$(F
       NC(FNL(V)))"{OFF}"TAB(1
       5);
FR 220 PRINTCHR$(18*-B)MID$(ST
       R$(V),2)"{OFF}"TAB(22);
HQ 230 IFV=32THENPRINT"
       {2 SPACES}"S$(V):GOTO18
       0
QM 240 IFV=34THENQ=NOTQ:PRINTC
       HR$(V):GOTO180
BR 250 IFV=141ANDNOTBTHENPRINT
       "{RVS}M{OFF} "S$(V):GOT
       O180
```

```
PK 260 IFV=255THENPRINT" ↑":GO
       TO180
RC 270 IFBTHENPRINT" ";:POKEA,
       V:SYS936:PRINT:GOTO180
FD 280 IFV>32THEN310
SF 290 PRINT"{RVS}"CHR$(V+64)"
       {OFF} "S$(V);:IFS$(V)="
       "THENPRINT"[CTRL-"CHR$(
       V+64)"]";
PK 300 PRINT:GOTO180
BP 310 IFV<128ORV>160THENPRINT
       CHR$(V):GOTO180
QF 320 PRINTQ$D$CHR$(V)Q$D$TAB
       (24)S$(V):GOTO180
XG 330 M=M-1:PRINT"{2 UP}";:PO
       KEX,PEEK(214):SYS59903:
       PRINT:FORI=0TO2
SD 340 PRINTM+ITAB(9)"00"TAB(1
       5)"0":NEXT:PRINT"{UP}"T
       AB(22)"{CYN}END OF PROG
       RAM[8]"
RB 350 POKE198,0:GOSUB400:PRIN
       T"{CLR}":GOTO130
FH 360 I$="{CLR}{2 DOWN}[8]BAS
       IC EXAMINER":DIMS$(160)
       :Q$=CHR$(34):D$=CHR$(20
       ):A=780:X=A+1
SB 370 Y=A+2:DEFFNH(F)=INT(F/D
       ):DEFFNL(F)=F-D*FNH(F):
       DEFFNC(F)=F+48-7*(F>9)
CP 380 FORI=5TO34:READS$(I):NE
       XT:FORI=129TO160:READS$
       (I):NEXT
RK 390 FORI=828TO931:READJ:POK
       EI,J:NEXT
DC 400 F$="":Q=0:IFPEEK(788)=4
       9THENPRINTI$:INPUT"
       {DOWN}PROGRAM NAME";F$
CF 410 F=LEN(F$):S$="":INPUT"
       {DOWN}START WITH LINE #
       ";S$:S=INT(VAL(S$)):IFF
       =0THENRETURN
BC 420 FORI=1TOF:POKE678+I,ASC
       (MID$(F$,I,1)):NEXT:POK
       E183,F:POKE157,128
QK 430 FORI=184TO188:READJ:POK
       EI,J:NEXT:POKEA,0:POKEX
       ,1:POKEY,8:SYS65493
KA 440 POKE44,8:SYS42291:POKE4
       4,192:IFST=64THENRETURN
GB 450 PRINT:IFST<0THENPOKEX,5
       :SYS42039
GJ 460 OPEN15,8,15:INPUT#15,A,
       B$:CLOSE15:PRINT"{DOWN}
       {RVS}"B$
RD 470 DATA WHITE,,,LOCK,UNLOC
       K,,,,RETURN,LOWER CASE,
       ,
QM 480 DATA CRSR DOWN,REV-ON,H
       OME,DEL,,,,,,,,RED,CRSR
        RIGHT,GREEN,BLUE,SPACE
RX 490 DATA NEXT LINE AT,LINE
       {SPACE}NUMBER
DX 500 DATA ORANGE,,,,F1,F3,F5
       ,F7,F2,F4,F6,F8,SHIFT-R
       ETURN,UPPER-CASE,,BLACK
CE 510 DATA CRSR UP,RVS-OFF,CL
       EAR,INST,BROWN,LT.RED,G
       RAY1,GRAY2,LT.GREEN,LT.
       BLUE
GQ 520 DATA GRAY3,PURPLE,CRSR
       {SPACE}LEFT,YELLOW,CYAN
       ,SHIFT-SPACE
EC 530 DATA 134,20,133,21,169,
       1,162,8,32,23,166,165,9
       5,166,96,96,120,169,127
       ,141
PQ 540 DATA 13,220,169,3,141,2
       1,3,169,120,141,20,3,16
       9,129,141,26,208,169,27
       ,141
AE 550 DATA 17,208,88,160,31,1
       85,35,167,153,167,3,136
       ,208,247,96,41,127,76,2
       10
QA 560 DATA 255,169,1,141,25,2
       08,162,250,160,199,169,
       21,44,18,208,16,6,162,5
       7,160
GE 570 DATA 197,169,133,142,18
       ,208,140,0,221,141,24,2
       08,173,13,220,41,1,240,
       3,76
CG 580 DATA 49,234,76,188,254,
       0,0,8,167,2
KK 140 GETA$:IFA$<>""THENAN=F:
       GOTO260
RQ 150 NEXT:GOSUB360
XG 160 GETA$:IFA$=""THEN160
MX 170 GOTO260
BD 180 SYSP,10,2:PRINT"YOU MUS
       T ENTER VALUES FOR":PRI
       NTTAB(2)"N1,N2,R1, AND
       {SPACE}R2."
BJ 190 SYSP,13,2:PRINT"THE SUM
        OF R1+R2 MUST BE <= 13
       5."
AS 200 SYSP,20,5:INPUT"N1,N2,R
       1,R2";N1,N2,R1,R2
AB 210 GOSUB400:IFT>135THENGOS
       UB280:GOTO90
EC 220 GOSUB310:GOSUB380:FORAN
       =0TOFSTEPS:RP=R1*SIN(N1
       *AN)+R2*SIN(N2*AN)
BK 230 GOSUB350:GETA$:IFA$<>""
       THENAN=F:GOTO260
DG 240 NEXT:GOSUB360
HQ 250 GETA$:IFA$=""THEN250
JA 260 POKE53265,PEEK(53265)AN
       D223:POKE53272,21:GOTO4
       0
ME 270 SYS58260
ED 280 SYSP,23,2:PRINT"INCORRE
       CT DATA ENTRY - TRY AGA
       IN"
ME 290 FORI=1TO10:POKEDC+24,15
       :FORJ=1TO3:NEXT
CH 300 POKEDC+24,0:FORJ=1TO2:N
       EXT:NEXT:FORI=0TO300:NE
       XT:RETURN
HM 310 PRINTCL$:SYSP,12,5:PRIN
       T"PRESS ANY KEY TO END
       {SPACE}DRAWING"
FB 320 SYSP,13,5:PRINT"AND RET
       URN TO MENU.":FORI=0TO2
       000:NEXT
BK 330 POKE53272,PEEK(53272)OR
       8
RX 340 SYSCB:SYSCN,BC+16*CC:PO
       KE53265,PEEK(53265)OR32
       :RETURN
FA 350 SYSPR,XS+RP*COS(AN),YS+
       SF*RP*SIN(AN):RETURN
XJ 360 POKEDC+24,15:POKEDC+1,1
       10:POKEDC+5,9:POKEDC+6,
       9:POKEDC+4,17:POKEDC+4,
       16
DR 370 RETURN
KB 380 S=.04-(N1+N2)*.0015-T*.
       00005:IFS<.005THENS=.00
       5
PX 390 RETURN
FQ 400 T=ABS(R1)+ABS(R2):RETUR
       N
FG 410 DATA 32,253,174,32,158,
       173,32,170,177,140,60,3
       ,141,61,3,32,253,174,32
JF 420 DATA 158,173,32,170,177
       ,140,62,3,173,62,3,74,7
       4,74,141,63,3,173,61,3,
       74
GK 430 DATA 173,60,3,106,74,74
       ,141,64,3,173,62,3,41,7
       ,141,65,3,173,60,3,41,7
       ,141
MF 440 DATA 66,3,169,7,56,237,
       66,3,141,66,3,169,0,141
       ,67,3,141,68,3,174,63,3
       ,240
RA 450 DATA 20,24,169,64,109,6
       7,3,141,67,3,169,1,109,
       68,3,141,68,3,202,208,2
       36
DJ 460 DATA 234,169,0,141,70,3
       ,173,64,3,141,69,3,14,6
       9,3,46,70,3,14,69,3,46,
       70,3
JA 130 GOSUB310:GOSUB380:FORAN
       =0TOFSTEPS:RP=R1+R2*SIN
       (N1*AN):GOSUB350
```


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BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Polar Art

(Article on page 98.)

Program 1: Polar Art—64 Version

```
FM 10  F=2*↑:XS=160:YS=100:SF=.
       73:BC=0:CC=1:PR=49152:CB
       =49365:CN=49408:P=49438
QE 20  DC=54272:CL$=CHR$(147):P
       RINTCL$:POKE53280,0:POKE
       53281,0
XP 30  FORI=PRTOPR+308:READD:PO
       KEI,D:NEXT:FORI=1TO3:REA
       DD$(I):NEXT
XB 40  PRINT"{CLR}"TAB(14)"
       {YEL}POLAR ART"
FJ 50  FORI=1TO3:SYSP,10+I*2,5:
       PRINTI"{LEFT}. "D$(I):NE
       XT
DP 60  SYSP,23,10:PRINT"YOUR SE
       LECTION? "
KG 70  GETA$:IFA$=""THEN70
DD 80  A=VAL(A$):IFA<1ORA>3THEN
       GOSUB290:GOTO40
JE 90  N1=0:N2=0:R1=0:R2=0:PRIN
       TCL$:SYSP,3,15:PRINTD$(A
       ):ONAGOTO100,180,270
AF 100 SYSP,10,0:PRINT"YOU MUS
       T ENTER VALUES FOR N,R1
       , AND R2."
XR 110 PRINT:PRINT"THE SUM OF
       {SPACE}R1+R2 MUST BE <=
        135."
BH 120 SYSP,20,5:INPUT"N,R1,R2
       ";N1,R1,R2:GOSUB400:IFT
       >135THENGOSUB280:GOTO90
JA 130 GOSUB310:GOSUB380:FORAN
       =0TOFSTEPS:RP=R1+R2*SIN
       (N1*AN):GOSUB350
```

```
AX 470 DATA 14,69,3,46,70,3,16
       9,0 133,251,169,32,133,
       252,24,165,251,109,67,3
       ,133
BP 480 DATA 251,165,252,109,68
       ,3,133,252,24,165,251,1
       09,69,3,133,251,165,252
       ,109
AP 490 DATA 70,3,133,252,24,16
       5,251,109,65,3,133,251,
       165,252,105,0,133,252,1
       69,1
HB 500 DATA 174,66,3,240,4,10,
       202,208,252,141,71,3,16
       0,0,177,251,13,71,3,145
       ,251
HD 510 DATA 96,162,32,169,0,13
       3,251,138,133,252,160,0
       ,169,0,145,251,200,208,
       251
HQ 520 DATA 232,224,63,208,239
       ,169,0,133,251,169,63,1
       33,252,160,0,169,0,145,
       251
PS 530 DATA 200,192,64,208,249
       ,96,32,253,174,32,158,1
       73,32,170,177,152,160,0
       ,153
KM 540 DATA 0,4,153,250,4,153,
       244,5,153,238,6,200,192
       ,250,208,239,96,32,43,1
       93
KB 550 DATA 132,251,32,43,193,
       166,251,76,240,255,32,2
       53,174,32,158,173,32,17
       0
QG 560 DATA 177,96,ART I,ART I
       I,QUIT
```

Program 2: Polar Art—128, Plus/4, and 16 Version

```
AQ 10 F=2*↑:XS=160:YS=100:SF=.
      73:BC=0:CC=1
QA 20 CL$=CHR$(147):PRINTCL$:C
      OLOR 0,1:COLOR4,7
FJ 30 FORI=1TO3:READD$(I):NEXT
XQ 40 PRINTCL$:CHAR1,14,1,"":P
      RINTCHR$(18)CHR$(158)" P
      OLAR ART ";CHR$(146)
PR 50 FORI=1TO3:CHAR 1,14,10+I
      *2,"":PRINTI;CHR$(157)CH
      R$(46)CHR$(32)D$(I):NEXT
PF 60 CHAR1,12,23,"":PRINTCHR$
      (158)"YOUR SELECTION? "
KG 70 GETA$:IFA$=""THEN70
DD 80 A=VAL(A$):IFA<1ORA>3THEN
      GOSUB290:GOTO40
AK 90 N1=0:N2=0:R1=0:R2=0:PRIN
      TCL$:CHAR1,15,3,"":PRINT
      D$(A):ONAGOTO100,180,270
BR 100 CHAR1,0,10,"":PRINT"YOU
       MUST ENTER VALUES FOR
       {SPACE}N,R1, AND R2."
XR 110 PRINT:PRINT"THE SUM OF
       {SPACE}R1+R2 MUST BE <=
       135."
XB 120 CHAR1,5,20,"":INPUT"N,R
       1,R2";N1,R1,R2:GOSUB370
       :IFT>135THENGOSUB280:GO
       TO90
MH 130 GOSUB300:GOSUB350:FORAN
       =0TOFSTEPS:RP=R1+R2*SIN
       (N1*AN):GOSUB330
KK 140 GETA$:IFA$<>""THENAN=F:
       GOTO260
DX 150 NEXT:GOSUB340
XG 160 GETA$:IFA$=""THEN160
MX 170 GOTO260
QR 180 CHAR1,2,10,"":PRINT"YOU
       MUST ENTER VALUES FOR"
       :PRINTTAB(2)"N1,N2,R1,
       {SPACE}AND R2."
HE 190 CHAR1,2,13,"":PRINT"THE
       SUM OF R1+R2 MUST BE <
       = 135."
CP 200 CHAR1,5,20,"":INPUT"N1,
       N2,R1,R2";N1,N2,R1,R2
QQ 210 GOSUB370:IFT>135THENGOS
       UB280:GOTO90
MS 220 GOSUB300:GOSUB350:FORAN
       =0TOFSTEPS:RP=R1*SIN(N1
       *AN)+R2*SIN(N2*AN)
RP 230 GOSUB330:GETA$:IFA$<>""
       THENAN=F:GOTO260
RA 240 NEXT:GOSUB340
HQ 250 GETA$:IFA$=""THEN250
QB 260 COLOR0,1:GRAPHIC 0,1:GO
       TO40
RE 270 PRINT"{CLR}":END
JD 280 CHAR1,4,23,"":PRINT"INC
       ORRECT DATA ENTRY - TRY
        AGAIN"
KG 290 VOL 6:SOUND 1,200,15:FO
       RTD=1TO700:NEXT:RETURN
BQ 300 PRINTCL$:CHAR1,5,12,"":
       PRINTCHR$(5)"PRESS ANY
       {SPACE}KEY TO END DRAWI
       NG"
CA 310 CHAR1,5,13,"":PRINT"AND
        RETURN TO MENU.":FORI=
       0TO1000:NEXT
PB 320 COLOR0,1:COLOR1,2:GRAPH
       IC 1,1:RETURN
FE 330 DRAW1,XS+RP*COS(AN),YS+
       SF*RP*SIN(AN):RETURN
GS 340 VOL6:SOUND 1,900,20:RET
       URN
FD 350 S=.04-(N1+N2)*.0015-T*.
       00005:IFS<.005THENS=.00
       5
XR 360 RETURN
EX 370 T=ABS(R1)+ABS(R2):RETUR
       N
DH 380 DATA ART I,ART II,QUIT
```

Mastering 128 Sound And Music

(Article on page 90.)

Minuet

```
CM 10 PRINT"{CLR}{5 DOWN}{TAB}
      {4 SPACES}MINUET (G MAJO
      R)":PRINT{9 SPACES}"
      {5 DOWN}{2 TAB}
      {3 SPACES}BY":PRINT"
      {5 DOWN}{TAB} JOHANN SEB
      ASTIAN BACH"
XP 20 TEMPO 10:VOL 6:PLAY"X0U9
      ":PLAY"V1T6V2T0"
GD 30 A$="V2O3HGV1O5QDO4IGIAIB
      V2O3QAV1O5IC":B$="V1O5QD
      V2O3.HBV1O4IGIRIGIR"
EP 40 C$="V1O5QEV2O4.HCV1O5ICI
      DIEI#F":D$="V1O5QGV2O3.H
      BV1O4IGIRIGIR"
DG 50 FOR R=1TO2:PLAY A$:PLAY
      {SPACE}B$:PLAY C$:PLAY D
      $:E$="V1O5QCV2O3.HAV1O5I
      DICO4IBIA"
MA 60 F$="V1O4QBV2O3.HGV1O5ICO
      4IBIAIG":G$="V1O4Q#FV2QD
      O3QBV1O4IGIAIBV2O3QGV1O4
      IG"
KE 70 H$="V1O4QBV2QDO3IDV1O4HA
      V2O4ICO3IBIA":PLAY E$:PL
      AY F$:PLAY G$:PLAY H$
XA 80 I$="V2O3HBV1O5QDO4IGIAIB
      V2O3QAV1O5IC":J$="V1O5QD
      V2O3QGQBV1O4IGIRIGV2O3QG
      "
DS 90 K$="V2O4.HCV1O5QEICIDIEI
      #F":L$="V1O5QGV2O3QBO4IC
      V1O4IGIRV2O3IBIAV1O4IGIR
      V2O3IG":PLAY I$:PLAY J$:
      PLAY K$:PLAY L$
QC 100 M$="V2O3HAV1O5QCIDICO4I
       BV2O3Q#FV1O4IA":N$="V1O
       4QBV2O3HGV1O5ICO4IBIAV2
       O3QBV1O4IG"
MR 110 O$="V1O4QAV2QCQDV1IBIAI
       GV2O3QDV1O4I#F":P$="V1O
       4.HGV2O3HGO2QG":PLAY M$
       :PLAY N$:PLAY O$:PLAY P
       $:NEXT R
BF 120 FOR R=1TO2:Q$="V2O3.HGV
       1O5QBIGIAIBIG":R$="V1O5
       QAV2O3.H#FV1O5IDIEI#FID
       "
CX 130 S$="V1O5QGV2O3QEQGV1O5I
       EI#FIGV2O3QEV1O5ID":T$=
       "V1O5Q#CV2O3HAV1O4IBO5I
       #CO4QAV2O2QA"
BP 140 VOL 8:PLAY Q$:PLAY R$:P
       LAY S$:PLAY T$:U$="V2O3
       .HAV1O4IAIBO5I#CIDIEI#F
       ":V$="V1O5QGV2O3IBIRO4Q
       DV1O5Q#FQEV2O4Q#C"
KH 150 W$="V2O4QDV1O5Q#FO4IAV2
       O3I#FIRIAV1O5I#CIR":X$=
       "V1O5.HDV2O4QDO3QDO4QC"
       :PLAY U$:VOL 10:PLAY V$
       :PLAY W$:PLAY X$
SQ 160 Y$="V2O3QBV1O5QDO4IGV2Q
       DV1I#FQGV2O3QB":Z$="V2O
       4QCV1O5QEO4IGV2QEV1I#FI
       GV2QC"
BX 170 AA$="V2O3QBV1O5QDQCV2O3
       QAQGV1O4QB":AB$="V1O4IA
       V2HDV1IGI#FIGQA":VOL 6:
       PLAY Y$:PLAY Z$:PLAY AA
       $:PLAY AB$
HE 180 AC$="V1O4IDV2O3HDV1O4IE
       I#FIGIAV2O3Q#FV1O4IB":A
       D$="V1O5QCV2O3QEQGV1O4Q
       BQAV2O3Q#F"
CK 190 AE$="V2O3QGV1O4IBO5IDO4
       IGV2O2IBIRO3IDV1O4I#FIR
       ":AF$="V1O4.HGV2O3IGIRI
       DIRO2IGIR"
RJ 200 PLAY AC$:VOL 8:PLAY AD$
       :PLAY AE$:PLAY AF$:NEXT
        R:END
```

64 Multitasker

See instructions in article on page 94 before typing in.

```
C000:4C 59 C0 78 A9 08 8D 88 AE
C008:02 A9 00 8D 00 52 8D 01 33
C010:52 8D 02 52 AA BD DF C2 52
C018:95 2B E8 E0 0E 90 F6 A9 A4
C020:02 8D FF C2 8D 00 C3 A9 CF
C028:25 8D 18 D0 A9 42 85 FB 0D
C030:A9 C0 85 FC A0 00 B1 FB 9B
C038:F0 06 20 D2 FF C8 D0 F6 A0
C040:58 60 93 0D 4D 55 4C 54 F5
C048:49 54 41 53 4B 45 52 20 15
C050:45 4E 41 42 4C 45 44 0D 61
C058:00 78 AD 14 03 8D F6 C2 ED
C060:A9 EC 8D 14 03 AD 15 03 E0
C068:8D F7 C2 A9 C0 8D 15 03 0B
C070:A9 20 8D F0 C2 A9 FF 8D D9
C078:FA C2 A2 A0 A0 A0 20 32 80
C080:C2 A2 E0 A0 E0 20 32 C2 E0
C088:AD 28 03 8D F8 C2 A9 C1 0C
C090:8D 28 03 AD 29 03 8D F9 88
C098:C2 A9 C2 8D 29 03 A9 35 F4
C0A0:85 01 A9 4C 8D 34 EB A9 DD
C0A8:AE 8D 35 EB A9 C2 8D 36 F3
C0B0:EB A9 86 8D DB E4 A9 02 04
```

```
C0B8:8D DC E4 AD F3 C2 8D F2 68
C0C0:C2 A9 04 8D F0 C2 A9 01 4E
C0C8:8D 00 C3 8D FF C2 A9 00 C0
C0D0:8D ED C2 8D D5 02 8D 00 97
C0D8:0C 8D 01 0C 8D 02 0C AA DB
C0E0:BD D1 C2 95 2B E8 E0 0E 34
C0E8:90 F6 58 60 AD D5 02 D0 1B
C0F0:21 A9 00 8D F1 C2 AD ED 2A
C0F8:C2 C9 40 D0 08 A9 00 8D D7
C100:EF C2 4C 22 C1 AD EF C2 3F
C108:D0 18 A9 01 8D EF C2 AD 9E
C110:ED C2 C9 04 F0 52 C9 05 1E
C118:F0 2B C9 06 F0 2D C9 03 4B
C120:F0 13 AD F4 C2 F0 11 CE B0
C128:F2 C2 D0 0C AD F3 C2 8D 01
C130:F2 C2 4C 5B C1 4C F9 C1 12
C138:A5 C5 8D ED C2 A9 00 8D DA
C140:D5 02 6C F6 C2 20 70 C2 66
C148:4C 5B C1 AD F4 C2 49 FF 21
C150:8D F4 C2 AD FF C2 CD 00 B1
C158:C3 F0 DD A9 01 8D F1 C2 35
C160:A5 C5 8D C5 98 8D C5 9C 59
C168:AD FF C2 C9 01 F0 07 C9 5B
C170:02 F0 48 4C 38 C1 BA 8E CB
C178:D6 02 A9 FF 8D FA C2 A2 9D
C180:00 A0 98 20 32 C2 AD F1 2B
C188:C2 F0 2D AE FD C2 8E B1 04
C190:C2 8E BD C2 E8 E8 8E B9 BE
C198:C2 A9 02 8D FF C2 A9 00 5F
C1A0:8D FA C2 A9 B4 8D FB C2 33
C1A8:A9 C1 8D FC C2 A2 9C A0 6D
C1B0:00 4C 32 C2 AE D6 02 9A 29
C1B8:4C 38 C1 BA 8E D6 02 A9 D1
C1C0:FF 8D FA C2 A2 00 A0 9C 26
C1C8:20 32 C2 AD F1 C2 F0 E8 81
C1D0:AE FE C2 8E B1 C2 8E BD 20
C1D8:C2 E8 E8 8E B9 C2 A9 01 2B
C1E0:8D FF C2 A9 00 8D FA C2 0D
C1E8:A9 B4 8D FB C2 A9 C1 8D AD
C1F0:FC C2 A2 98 A0 00 4C 32 51
C1F8:C2 A9 01 85 FB A9 C3 85 54
C200:FC A4 D3 B1 FB F0 05 91 02
C208:D1 C8 D0 F7 AD FF C2 18 4D
C210:69 30 91 D1 E6 D6 A5 D6 5A
C218:C9 18 B0 12 A5 D1 18 69 CD
C220:28 85 D1 90 02 E6 D2 A9 59
C228:00 85 D3 4C 38 C1 C6 D6 7B
C230:D0 F5 86 FC 8E FC 98 8E 64
C238:FC 9C 84 FE 8C FE 98 8C 02
C240:FE 9C AE F0 C2 A0 00 84 6E
C248:FB 8C FB 98 8C FB 9C 84 0A
C250:FD 8C FD 98 8C FD 9C B1 88
C258:FB 91 FD C8 D0 F9 EE FC D5
C260:00 EE FE 00 CA D0 F0 AD AA
C268:FA C2 F0 01 60 6C FB C2 B9
C270:AD 00 C3 C9 01 F0 17 A9 85
C278:01 8D 00 C3 A9 10 8D F5 BC
C280:C2 A9 98 8D FD C2 A9 00 0C
C288:8D FE C2 4C A2 C2 A9 02 27
C290:8D 00 C3 A9 20 8D F5 C2 D5
C298:A9 00 8D FD C2 A9 9C 8D 08
C2A0:FE C2 AD 18 D0 29 0F 0D E3
C2A8:F5 C2 8D 18 D0 60 8A AE D8
C2B0:C6 00 EC 89 02 B0 07 9D 4E
C2B8:77 02 E8 8E C6 00 4C 42 91
C2C0:EB AD FF C2 CD 00 C3 D0 9A
C2C8:03 6C F8 C2 A9 FF C9 7F 96
C2D0:60 01 0C 03 0C 03 0C 03 FF
C2D8:0C 00 52 00 52 00 52 01 E6
C2E0:52 03 52 03 52 03 52 00 0E
C2E8:98 00 98 00 98 00 00 00 92
C2F0:04 00 00 03 00 10 AA AA E8
C2F8:AA AA 00 AA AA 02 02 01 8B
C300:01 15 13 09 0E 07 20 02 0F
C308:0C 0F 03 0B 20 23 00 00 F7
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

128 Draw

(Article on page 99.)

```
QG 10 CLR:GRAPHIC1,1:COLOR1,1:
      COLOR4,1
HG 20 DRAW 1,10,2TO10,7:DRAW 1
      ,1,11TO4,11:DRAW 1,10,15
      TO10,21:DRAW 1,17,11TO20
      ,11
MX 30 SSHAPEA$,1,1,22,22:SPRSA
      V A$,1:T=0:C=1:F=1:X=99:
      Y=160
SE 40 SPRITE1,1:COLOR0,2:GRAPH
      IC1,1
RG 50 J=JOY(2):MOVSPR1,Y+15,X+
      40
QR 60 GETA$:IF A$="F" THEN F=-
      F+1:GOTO 50
PG 70 IF F=1 AND A$="" THEN 30
      0:ELSE 90
QK 80 IF A$="D" THEN D=-D+1:GO
      TO 50
KK 90 IF A$="C" THEN BEGIN:ELS
      E 140
SG 100 C=C+1:IF C>16 THEN C=1:
       ELSE C=C
QF 110 COLOR1,C:COLOR 4,C
KM 120 BEND
AS 130 IF A$="C" THEN COLOR1,C
       :COLOR4,C
JG 140 IF A$="S" OR A$="L" THE
       N 530
RQ 150 IF A$="X" AND T=0 THEN
       {SPACE}SPRITE1,0:T=1:GO
       TO 50
ED 160 IF A$="O" AND RAD=0 AND
        BOT=0 THEN 580
MC 170 IF BOT=1 AND A$="O" THE
       N 600
FJ 180 IF RAD=1 AND A$="O" THE
       N 590
AK 190 IF A$="X" AND T=1 THEN
       {SPACE}SPRITE1,1:T=0:GO
       TO 50
BE 200 IF A$="W" AND W=0 THEN
       {SPACE}WIDTH2:W=1:GOTO
       {SPACE}50
GM 210 IF A$="W" AND W=1 THEN
       {SPACE}WIDTH1:W=0:GOTO
       {SPACE}50
SR 220 IF A$="B"AND B=1 THEN 6
       30
CD 230 IF A$="B"AND B=0 THEN 6
       20
EJ 240 IF A$="E" THEN GRAPHIC1
       ,1:X=99:Y=160:C=1:COLOR
       4,C:COLOR1,C:GOTO 50
ES 250 IF A$="P"THEN 520
PB 260 IF A$="T" THEN 640
AE 270 IF A$="D" THEN D=-D+1:G
       OTO 50
EG 280 IF P=1 AND A$="P" THEN
       {SPACE}520
XE 290 IF A$="4" THEN X=99:Y=1
       60:GOTO 50
FR 300 IF A$="1" THEN X=0:Y=0:
       GOTO 50
SX 310 IF A$="2" THEN X=0:Y=31
       9:GOTO 50
FC 320 IF A$="3" THEN X=199:Y=
       0:GOTO 50
CH 330 IF A$="4" THEN X=199:Y=
       319:GOTO 50
HJ 340 IF J=0 THEN 50
BA 350 ON J GOSUB 390,380,420,
       410,440,460,500,490
DJ 360 IF D=1 THEN 50
HD 370 DRAW1,Y,X:GOTO 50
HX 380 Y=Y+1:IF Y>319 THEN Y=3
       19
EP 390 X=X-1:IF X<0 THEN X=0
AS 400 RETURN
QC 410 X=X+1:IF X>199 THEN X=1
       99
CK 420 Y=Y+1:IF Y>319 THEN Y=3
       19
RB 430 RETURN
JQ 440 X=X+1:IF X>199 THEN X=1
       99
FC 450 RETURN
AS 460 X=X+1:IF X>199 THEN X=1
       99
XD 470 Y=Y-1:IF Y<0 THEN Y=0
BE 480 RETURN
BR 490 X=X-1:IF X<0 THEN X=0
SC 500 Y=Y-1:IF Y<0 THEN Y=0
AF 510 RETURN
FB 520 D=1:PAINT1,Y,X:GOTO 50
FA 530 GRAPHIC0,1:COLOR0,2:COL
       OR5,1:SPRITE1,0
GG 540 INPUT"FILENAME: ";N$:IF
        A$="L" THEN 560
MP 550 PRINT"{2 DOWN}SAVING "N
       $:BSAVE(N$),B0,P7168 TO
        P16384:GRAPHIC1:SPRITE
       1,1:GOTO 50
FC 560 IF N$="D" THEN CATALOG:
       GOTO 540
JS 570 PRINT"{2 DOWN}LOADING "
       ;N$:BLOAD(N$),B0,P7168:
       T=1:D=1:GRAPHIC1:GOTO 5
       0
FX 580 XC=X:YC=Y:RAD=1:GOTO 50
PX 590 R=ABS(YC-Y):BOT=1:DRAW1
       ,Y,X:RAD=0:GOTO 50
PC 600 IF X=XC THEN BR=R:ELSE
       {SPACE}BR=ABS(XC-X)
DD 610 CIRCLE1,YC,XC,R,BR:BOT=
       0
DM 620 B=1:D=1:X1=X:Y1=Y:GOTO
       {SPACE}50
BC 630 X2=X:Y2=Y:BOX1,Y1,X1,Y2
       ,X2:B=0:GOTO 50
GQ 640 XT=INT(X/8):YT=INT(Y/8)
       :GRAPHIC0,1:INPUT"TEXT:
        ";T$:GRAPHIC1:CHAR1,YT
       ,XT,T$:GOTO 50
```

Obstacle 128

(Article on page 46.)

```
RC 10 GRAPHIC3,1:SOUND 3,100,3
      0000
RE 20 COLOR 0,1:COLOR3,7:COLOR
      2,5:SOUND 2,20000,150,0,
      2000,100:COLOR 4,1:S=INT
      (RND(.)*40)+30
AP 30 DRAW2,1,1+STO158,1+STO15
      8,198-S:DRAW3,158,198-ST
      O1,198-STO1,2+S:COLOR1,8
      :CHAR1,16,22,"OBSTACLE"
MP 40 X=30+INT(RND(.)*40):Y=10
      0:A=80+INT(RND(.)*40):B=
      100:J=INT(RND(.)*3)-1:K=
      INT(RND(.)*3)-1:L=J:M=K:
      IFABS(J+K)<>1THEN40
SA 50 J1=JOY(1):IFJ1=0THEN100
EC 60 IFJ1=3THENJ=+1:K=0
```

```
DF 70 IFJ1=7THENJ=-1:K=0
FA 80 IFJ1=1THENK=-1:J=0
AH 90 IFJ1=5THENK=+1:J=0
MC 100 LOCATEX+J,Y+K:IFRDOT(2)
       >1THENJ3=1
FK 110 X=X+J:Y=Y+K:DRAW 3,X,Y
GR 120 J2=JOY(2):IFJ2=0THEN170
RJ 130 IFJ2=3THENL=+1:M=0
QD 140 IFJ2=7THENL=-1:M=0
SS 150 IFJ2=1THENM=-1:L=0
SR 160 IFJ2=5THENM=+1:L=0
XM 170 LOCATEA+L,B+M:IFRDOT(2)
       >1THENJ4=1
RA 180 A=A+L:B=B+M:DRAW 2,A,B
FS 190 IFJ3=1ORJ4=1THEN210
GA 200 GOTO50
GQ 210 SOUND 2,40000,70,1,050,
       1915,3,4000:IF J4=1 THE
       N CHAR2,29,1,"CRASHED":
       C=C+1:ELSE240
MP 220 LOCATE X+J,Y+K:IFRDOT(2
       )=3ORRDOT(2)=2THENJ3=1
HA 230 X=X+J:Y=Y+K:DRAW 3,X,Y
BC 240 IFJ3=1 THEN CHAR3,3,1,"
       CRASHED":D=D+1
AG 250 IFJ3=1 AND J4=1 THEN CH
       AR 1,12,20,"YOU BOTH CR
       ASHED":SOUND 1,5000,90,
       2,3000,500,1
FE 260 SOUND1,1024,60,0,0,0,3,
       0:SLEEP1:GRAPHIC3,1:A$=
       STR$(C):CHAR1,3,22,"SCO
       RE: "+A$
PC 270 A$=STR$(D):CHAR1,29,22,
       "SCORE: "+A$
XJ 280 IFD>4 AND D>C THEN CHAR
        2,29,1,"YOU WON":GOTO3
       10
JA 290 IFC>4 AND C>D THEN CHAR
        3,3,1, "YOU WON":GOTO3
       10
CM 300 J3=0:J4=0:GOTO20
EJ 310 TEMPO30:PLAY"V2T704 H C
       CCCCCD R CC RR CCCCCCDF
       G RRRCCFA R $ B R AGA G
       "
SS 320 SOUND 3,0,0:PRINT"{CLR}
       ":GRAPHIC 0:END
```

Match Blox

(Article on page 50.)

Program 1: Match Blox—64 Version

```
XC 100 GOSUB820:POKE 53280,6:P
       OKE 53281,6:PRINT CHR$(
       8)"{CLR}{2 DOWN}{7}"SPC
       (14)"MATCH BLOX{2 DOWN}
       "
FE 110 L$(1)="{1}{RVS}O{Y}P
       {DOWN}{3 LEFT}{H} {N}
       {DOWN}{3 LEFT}L{P}@
       {OFF}{2 UP}":L$(2)="{7}
       "+RIGHT$(L$(1),21)
MQ 120 NA$(1)="UNI-COLOR":NA$(
       2)="{2 SPACES}CROSS":NA
       $(3)="NO CENTER"
HH 130 NA$(4)="4 CORNERS":NA$(
       5)=" 5 POINTS":MV$="MOV
       ES"
JR 140 DIM Y(10),P$(10),CL(5,9
       ):FOR I=1 TO 9:READ V(I
       ,1),V(I,2),V(I,3),V(I,4
       )
SH 150 NEXT:MT=1:UP=8:DN=14:LM
       =16:RM=22:TE=5:QX=11:QY
       =19:MV=-1:Q=14:X=8:P=0
QK 160 FOR C=1 TO 9:Y(C)=X:P$(
       C)=L$(2):Z=INT(10*RND(1
       ))
RD 170 IF Z<=5 THEN Y(C)=Q:P$(
       C)=L$(1)
MR 180 NEXT
GM 190 T$="{RVS}OP{DOWN}
       {2 LEFT}L@{UP}":FOR RX=
       1 TO 5:FOR I=1 TO 9:CL(
       RX,I)=8:NEXT I,RX
PD 200 FOR I=1 TO 9:CL(1,I)=14
       :CL(3,I)=14:NEXT:CL(3,5
       )=8
XD 210 CL(2,2)=14:CL(2,4)=14:C
       L(2,5)=14:CL(2,6)=14:CL
       (2,8)=14
CF 220 CL(4,1)=14:CL(4,3)=14:C
       L(4,7)=14:CL(4,9)=14
JC 230 CL(5,1)=14:CL(5,3)=14:C
       L(5,5)=14:CL(5,7)=14:CL
       (5,9)=14
MF 240 PRINT SPC(12)"{8}{P}
       {DOWN}{2 LEFT}{N}{RVS}1
       {OFF}{H}{DOWN}{2 LEFT}
       {Y}{UP}{RIGHT}{7} UNI-C
       OLOR{DOWN}":PRINT SPC(1
       2);
CP 250 PRINT"{8}{P}{DOWN}
       {2 LEFT}{N}{RVS}2{OFF}
       {H}{DOWN}{2 LEFT}{Y}
       {UP}{RIGHT}{7} CROSS
       {DOWN}":PRINTSPC(12)"
       {8}{P}{DOWN}{2 LEFT}{N}
       {RVS}3{OFF}{H}{DOWN}
       {2 LEFT}{Y}{UP}{RIGHT}
       {7} NO CENTER{DOWN}"
QG 260 PRINT SPC(12)"{8}{P}
       {DOWN}{2 LEFT}{N}{RVS}4
       {OFF}{H}{DOWN}{2 LEFT}
       {Y}{UP}{RIGHT}{7} 4 COR
       NERS{DOWN}"
QQ 270 PRINT SPC(12)"{8}{P}
       {DOWN}{2 LEFT}{N}{RVS}5
       {OFF}{H}{DOWN}{2 LEFT}
       {Y}{UP}{RIGHT}{7} 5 POI
       NTS{3 DOWN}"
AE 280 PRINT TAB(12);"YOUR CHO
       ICE{UP}{2 SPACES}{8}{P}
       {DOWN}{2 LEFT}{N}{RVS}
       {SPACE}{OFF}{H}{DOWN}
       {2 LEFT}{Y}{7}"
AB 290 S=127-PEEK(56320):IF S=
       4 THEN MT=MT-1:IF MT<1
       {SPACE}THEN MT=1
DE 300 IF S=8 THEN MT=MT+1:IF
       {SPACE}MT>5 THEN MT=5
HB 310 IF S>=15 THEN DZ=MT:GK=
       MT:GOTO 330
HR 320 POKE 1929,MT+176:POKE 5
       6201,15:GOTO 290
FB 330 PRINT CHR$(31)"{CLR}";
HJ 340 FOR I=0 TO 23:PRINT"
       {RVS}{BLU}{39 SPACES}"
HP 350 MM=1063+(40*I):POKE MM,
       160:POKE MM+54272,6:NEX
       T:POKE 2023,160:POKE 56
       295,6
BD 360 PRINT"{RVS}{39 SPACES}
       {HOME}":POKE 53281,15
RH 370 PRINT"{HOME}{2 DOWN}";:
       PRINT SPC(15)"{RVS}"NA$
       (GK)"{2 DOWN}"
SP 380 PRINT"{HOME}{7 DOWN}"SP
       C(3)"{RVS}{BLU}M{DOWN}A
       {DOWN}T{DOWN}C{DOWN}H
       {2 DOWN}{3 LEFT}B{DOWN}
       L{DOWN}O{DOWN}X"
DC 390 E=1:F=3:PRINT"{HOME}
       {8 DOWN}":FOR BJ=1 TO 3
       :PRINT SPC(31);:FOR AI=
       E TO F
FM 400 POKE 646,CL(GK,AI):PRIN
       T T$;:NEXT:E=E+3:F=F+3:
       PRINT"{DOWN}":NEXT
DS 410 GOSUB 420:GOTO 450
DQ 420 PRINT"{HOME}{7 DOWN}"TA
       B(15)"{RVS}"P$(1)P$(2)P
       $(3):PRINT"{2 DOWN}"TAB
       (15)"{RVS}"P$(4)P$(5)P$
       (6)
QG 430 PRINT"{2 DOWN}"TAB(15)"
       {RVS}"P$(7)P$(8)P$(9)
XQ 440 POKE 782,QY:POKE 781,QX
       :POKE 783,0:SYS 65520:P
       RINT"{BLK}{+}{LEFT}";:R
       ETURN
EK 450 MV=MV+1:U=0:FOR C=1 TO
       {SPACE}9:IF Y(C)=X THEN
        U=U+1
MH 460 NEXT:IF TC=1 THEN TC=0:
       MV=MV-1
FQ 470 IF MV>0 THEN PRINT"
       {HOME}{20 DOWN}{RVS}
       {BLU}"SPC(16)"MOVE"MV:G
       OSUB 440
DD 480 IF GK=1 AND U=9 THEN 75
       0
BA 490 IF U=9 THEN 780
QD 500 IF GK=2 AND U=5 AND Y(2
       )+Y(4)+Y(5)+Y(6)+Y(8)=4
       0 THEN 750
KP 510 IF GK=3 AND U=8 AND Y(5
       )=14 THEN 750
CQ 520 IF GK=4 AND U=4 AND Y(1
       )+Y(3)+Y(7)+Y(9)=32 THE
       N 750
KF 530 IF GK=5 AND U=5 AND Y(1
       )+Y(3)+Y(5)+Y(7)+Y(9)=4
       0 THEN 750
FF 540 GOTO 610
AF 550 P=U:IF Y(U)=X THEN TC=1
       :GOSUB 420:GOTO 450
FA 560 W(1)=V(U,1):W(2)=V(U,2)
       :W(3)=V(U,3):W(4)=V(U,4
       )
GQ 570 FOR G=1 TO 4:W=0:IF Y(W
       (G))=X THEN W=1
KG 580 IF W=1 THEN Y(W(G))=Q:P
       $(W(G))=L$(1)
RX 590 IF W=0 AND Y(W(G))=Q TH
       EN Y(W(G))=X:P$(W(G))=L
       $(2)
XK 600 NEXT:Y(U)=X:P$(U)=L$(2)
       :GOSUB420:GOTO450
KE 610 POKE 204,0:JY=15-PEEK(5
       6320)AND15:JB=16-PEEK(5
       6320)AND16
GX 620 IF JB=0 THEN GOSUB 820:
       U=TE:GOTO 550
PB 630 IF JY=8 THEN JY=3
CE 640 IF JY<1 ORJY>4 THEN 610
CJ 650 GOSUB 820:ON JY GOTO 66
       0,680,700,720
QS 660 IF QX=UP THEN 610
HQ 670 QX=QX-3:TE=TE-3:GOTO 74
       0
PB 680 IFQX=DN THEN 610
PR 690 QX=QX+3:TE=TE+3:GOTO 74
       0
PK 700 IF QY=RM THEN 610
FD 710 QY=QY+3:TE=TE+1:GOTO 74
       0
KP 720 IF QY=LM THEN 610
FR 730 QY=QY-3:TE=TE-1
CD 740 GOSUB 420:GOTO 610
DK 750 IF MV=1 THEN MV$="MOVE"
XC 760 GOSUB 830:PRINT"{RVS}
       {BLU}{7 SPACES}YOU SOLV
       ED IT IN"MV;MV$:S1=30:S
       2=20:S3=-1
SF 770 GOSUB 840:GOTO 800
QS 780 GOSUB 830:PRINT"{RVS}
       {BLU}{5 SPACES}NO MOVES
        AVAILABLE...GAME OVER"
       :S1=17:S2=35:S3=1
```

```
JE 790 GOSUB 840
BA 800 PRINT"{DOWN}{RVS}
       {5 SPACES}PRESS FIREBUT
       TON TO PLAY AGAIN{HOME}
       "
CP 810 WAIT 56320,16,16:FOR I=
       54272 TO 54287:POKE I,0
       :NEXT:RUN
XX 820 POKE 204,1:POKE 207,0:R
       ETURN
DK 830 GOSUB 440:PRINT"{RVS}
       {7} {HOME}{19 DOWN}":RE
       TURN
CD 840 POKE 54296,15:POKE 5429
       5,0:POKE 54273,40:POKE
       {SPACE}54278,240:POKE 5
       4277,0
AE 850 POKE 54276,17:FOR A=S1
       {SPACE}TO S2 STEP S3:FO
       R B=A TO 60-A
JD 860 POKE 54273,B:NEXT B,A:P
       OKE 54273,3:POKE 54276,
       0:RETURN
GE 870 DATA 2,4,5,10,1,3,10,10
       ,2,5,6,10,1,7,10,10,2,4
       ,8,6,3,9,10,10,4,5,8,10
       ,7,9
GS 880 DATA 10,10,8,5,6,10,0,0
       ,0,0,0,0,0,0,0,0,0,0,0,
       0,0,1,240,0,3,248,0,7,2
       52,0
QG 890 DATA 7,252,0,7,252,0,3,
       248,0,1,240,0,0,0,0,0,0
       ,0,0,0,0,0,0,0,0,0,0,0,
       0,0
MB 900 DATA 0,0,0,0,0,0,0,0,0,0,
       190
```

Program 2: Match Blox—Line Substitutions For The Plus/4 and 16

```
AJ 10 DIMJ(15):J(1)=1:J(3)=8:J
      (5)=2:J(7)=4
BB 100 COLOR4,7,4:COLOR0,7,4:P
       RINT CHR$(8)"{CLR}
       {2 DOWN}{7}"SPC(14)"MAT
       CH BLOX{2 DOWN}"
HX 290 S=JOY(1):IF S=7 THEN MT
       =MT-1:IF MT<1 THEN MT=1
PB 300 IF S=3 THEN MT=MT+1:IF
       {SPACE}MT>5 THEN MT=5
CX 320 POKE 3977,MT+176:POKE 2
       953,15:GOTO290
HK 350 MM=3111+(40*I):POKE MM,
       160:POKE MM-1024,7:NEX
       T:POKE 4071,160:POKE 30
       47,7
SS 360 PRINT"{RVS}{39 SPACES}
       {HOME}":COLOR0,15
GX 400 POKE 1339,CL(GK,AI):PRI
       NT T$;:NEXT:E=E+3:F=F+3
       :PRINT"{DOWN}":NEXT
PS 440 POKE 2036,QY:POKE 2035,
       QX:POKE2037,0:SYS65520:
       PRINT"{BLK}{3}";:RETURN
AC 610 JY=J(JOY(1)AND15):JB=1-
       (JOY(1)AND128)/128
XM 810 IF (JOY(1)AND128)<>128
       {SPACE}THEN 810
EC 815 RUN
DD 830 GOSUB 440:PRINT"{RVS}
       {LEFT}{7} {HOME}
       {19 DOWN}":RETURN
```

Fill-64

See instructions in article on page 76 before typing in.

Program 1: Fill-64

```
83FF:FF 4C 24 88 4C 92 87 4C 2F
8407:78 88 4C 93 88 4C 49 8F C8
840F:4C 86 84 4C 47 88 4C 65 8F
8417:88 4C FB 88 4C FF 88 4C 3F
841F:C9 88 4C CF 88 4C E1 88 77
8427:4C F3 88 4C F7 88 4C F0 94
842F:88 4C F1 88 4C F2 88 A9 3F
8437:8C 8D 04 03 A9 84 8D 05 1A
843F:03 A9 51 8D 06 03 A9 85 4C
8447:8D 07 03 A9 ED 8D 08 03 8C
844F:A9 85 8D 09 03 A9 00 8D 1D
8457:DF 9F 8D DE 9F 8D 17 9F D8
845F:8D 05 40 A9 00 8D 1F 9F 27
8467:A9 40 8D 20 9F A9 01 8D 3C
846F:00 40 8D 04 40 A9 06 8D BC
8477:01 40 A9 00 8D 02 40 A9 E4
847F:07 8D 03 40 4C A9 8E 20 1A
8487:F5 96 4C 61 97 A6 7A A0 BD
848F:04 84 0F BD 00 02 10 07 A8
8497:C9 FF F0 3E E8 D0 F4 C9 C5
849F:20 F0 37 85 08 C9 22 F0 D0
84A7:56 24 0F 70 2D C9 3F D0 AD
84AF:04 A9 99 D0 25 C9 30 90 A6
84B7:04 C9 3C 90 1D 84 71 A0 44
84BF:00 84 0B 88 86 7A CA C8 50
84C7:E8 BD 00 02 38 F9 9E A0 5C
84CF:F0 F5 C9 80 D0 30 05 0B 6C
84D7:A4 71 E8 C8 99 FB 01 B9 B1
84DF:FB 01 F0 38 38 E9 3A F0 97
84E7:04 C9 49 D0 02 85 0F 38 18
84EF:E9 55 D0 9F 85 08 BD 00 1F
84F7:02 F0 DF C5 08 F0 DB C8 1B
84FF:99 FB 01 E8 D0 F0 A6 7A 95
8507:E6 0B C8 B9 9D A0 10 FA 87
850F:B9 9E A0 D0 B4 F0 0F BD 05
8517:00 02 10 BC 99 FD 01 C6 FD
851F:7B A9 FF 85 7A 60 A0 00 41
8527:B9 87 85 D0 02 E8 C8 BD B1
852F:00 02 38 F9 87 85 F0 F5 8B
8537:C9 80 D0 04 05 0B D0 98 30
853F:A6 7A E6 0B C8 B9 86 85 89
8547:10 FA B9 87 85 D0 E0 4C 46
854F:16 85 10 0F C9 FF F0 0B F4
8557:24 0F 30 07 C9 CC B0 06 97
855F:4C 24 A7 4C F3 A6 38 E9 E7
8567:CB AA 84 49 A0 FF CA F0 B3
856F:09 C8 B9 87 85 10 FA 4C 8F
8577:6D 85 C8 B9 87 85 30 05 07
857F:20 47 AB D0 F5 4C EF A6 56
8587:53 45 54 43 4F 4C 4F D2 69
858F:46 49 4C CC 53 57 49 54 45
8597:43 C8 46 4C 49 D0 4C 4F 79
859F:57 52 45 D3 43 4C 45 41 E7
85A7:D2 52 45 43 4F 52 C4 50 2B
85AF:4C 41 D9 44 50 55 D4 44 76
85B7:47 45 D4 52 45 57 49 4E DF
85BF:C4 45 52 41 53 C5 4D 45 6E
85C7:4D 4F 52 D9 43 50 55 D4 10
85CF:43 47 45 D4 54 55 52 42 23
85D7:4F 50 55 D4 54 55 52 42 75
85DF:4F 47 45 D4 52 45 4C 4F E9
85E7:43 41 54 C5 00 00 20 73 7F
85EF:00 20 F6 85 4C AE A7 C9 70
85F7:CC 90 04 C9 DE 90 06 20 10
85FF:79 00 4C ED A7 38 E9 CC EE
8607:0A AA BD 15 86 48 BD 14 B1
860F:86 48 4C 73 00 FF 83 02 3B
8617:84 05 84 08 84 0B 84 0E 20
861F:84 11 84 14 84 17 84 1A 28
8627:84 1D 84 20 84 23 84 26 30
862F:84 29 84 2C 84 2F 84 32 38
8637:84 AD 00 9D D0 01 60 C9 E0
863F:03 10 0C AD 01 9D 2D DF E6
8647:9F D0 03 4C B4 86 60 A0 9E
864F:00 20 7E 86 A0 09 20 94 9A
8657:86 20 89 8D 20 B0 8C A0 37
865F:03 20 7E 86 A0 06 20 94 20
8667:86 20 89 8D 20 BC 8C A9 80
866F:00 8D DF 9F AD 0B 9F 30 DE
8677:3C A9 80 8D DF 9F 60 20 54
867F:AA 86 AD 08 9F 8D 1C 9F C4
8687:AD 09 9F 8D 1D 9F AD 0A 47
868F:9F 8D 1E 9F 60 20 AA 86 EC
8697:AD 1C 9F 8D 02 9F AD 1D 56
869F:9F 8D 03 9F AD 1E 9F 8D EC
86A7:04 9F 60 20 E4 8B 20 0A 4C
86AF:8C 20 56 8C 60 AD 00 9D F5
86B7:C9 02 10 24 AD 02 9D 0D 2C
86BF:04 9D 0D 05 9D 0D 07 9D F4
86C7:D0 EA AD 03 9D 38 E9 A0 20
86CF:B0 E2 AD 06 9D 38 E9 C8 6E
86D7:B0 DA 20 04 88 4C 29 87 87
86DF:C9 03 10 39 20 51 89 20 A1
86E7:04 88 AD 00 9D C9 02 10 F6
86EF:01 60 F0 21 AD 02 9D CD 44
86F7:04 9D D0 14 AD 03 9D CD 4C
86FF:05 9D D0 0C AD 06 9D 8D 20
8707:04 9D AD 07 9D 8D 05 9D 70
870F:A9 02 8D 00 9D A9 00 8D 46
8717:06 9D 4C 29 87 20 51 89 95
871F:AD 00 9D C9 03 90 18 20 FF
8727:04 88 AD 17 9F F0 03 20 68
872F:3F 87 A9 00 8D 20 98 A9 BC
8737:9D 8D 21 98 20 30 90 60 69
873F:AD 00 9D 0A 69 06 6D 18 CF
8747:9F A9 00 6D 19 9F C9 80 C2
874F:90 06 20 49 8F 4C 35 A4 7D
8757:A9 02 8D 20 D0 AD 18 9F 7C
875F:85 FB AD 19 9F 85 FC AD 32
8767:00 9D 0A 69 02 A8 18 65 FD
876F:FB 8D 18 9F A9 00 65 FC F1
8777:8D 19 9F C8 98 18 65 FB FF
877F:8D 1F 9F A9 00 65 FC 8D C8
8787:20 9F B9 00 9D 91 FB 88 79
878F:10 F8 60 20 8A AD 20 9B D9
8797:BC A5 65 8D 00 9D 20 FD A8
879F:AE 20 8A AD 20 9B BC A5 C8
87A7:65 8D 01 9D A9 00 8D 1B 4A
87AF:9F 8D 1A 9F 20 FD AE 20 A5
87B7:8A AD 20 9B BC 20 CE 87 C0
87BF:EE 1A 9F AD 1A 9F 4A CD 4D
87C7:00 9D 90 E8 4C 38 86 AC DB
87CF:1B 9F A9 00 99 02 9D A5 3F
87D7:65 99 03 9D A5 64 99 04 30
87DF:9D 10 1A A9 FF 99 02 9D A7
87E7:B9 03 9D 49 FF 18 69 01 11
87EF:99 03 9D B9 04 9D 49 FF 05
87E7:69 00 99 04 9D 98 18 69 18
87FF:03 8D 1B 9F 60 AD 00 9D A8
8807:0A 8D 1B 9F A2 01 A0 00 38
880F:BD 02 9D 99 02 9D E8 E8 0E
8817:E8 C8 CC 1B 9F 90 F1 A9 E6
881F:00 99 02 9D 60 A9 00 8D E7
8827:1B 9F 20 8A AD 20 9B BC 3C
882F:A5 65 AE 1B 9F EE 1B 9F 82
8837:9D 00 40 E0 04 10 06 20 B9
883F:FD AE 4C 29 88 4C 78 8F 0D
8847:A9 80 8D 17 9F A9 02 8D A5
884F:20 D0 A9 05 8D 18 9F A9 DF
8857:40 8D 19 9F 60 A9 00 8D 40
885F:17 9F 20 78 8F 60 20 5C 0A
8867:88 A9 05 8D 20 98 A9 40 97
886F:8D 21 98 20 51 88 4C 30 1A
8877:90 AD 17 9F 10 13 A9 80 B9
887F:20 AE 88 AD 18 9F 18 69 11
8887:01 8D 18 9F 90 03 EE 19 01
888F:9F 4C E3 8F AD 17 9F 10 12
8897:13 A9 40 20 AE 88 AD 18 B1
889F:9F 18 69 01 8D 18 9F 90 60
88A7:03 EE 19 9F 4C 0E 90 AC 7B
88AF:18 9F 84 FB AC 19 9F 84 92
88B7:FC A0 00 91 FB 98 C8 91 ED
88BF:FB EE 1F 9F D0 03 EE 20 F8
88C7:9F 60 20 5C 88 4C 51 88 2B
88CF:A9 00 8D 05 40 A9 00 8D ED
88D7:1F 9F A9 40 8D 20 9F 4C 12
```

```
88DF:C9 88 A9 00 38 ED 1F 9F 84
88E7:AA A9 80 ED 20 9F 4C CD 8D
88EF:BD 60 60 60 A9 01 D0 0C 09
88F7:A9 01 D0 2A A9 08 D0 04 ED
88FF:A9 08 D0 22 AA A0 01 20 1E
8907:BA FF 20 43 89 A9 00 85 28
890F:FB A9 40 85 FC A9 FB AE 20
8917:1F 9F AC 20 9F 20 D8 FF 68
891F:90 03 4C F9 E0 60 AA A0 E2
8927:01 20 BA FF 20 43 89 A9 E4
892F:00 A2 00 A0 40 20 D5 FF 23
8937:90 03 4C D1 E1 8E 1F 9F 21
893F:8C 20 9F 60 A9 00 20 BD E5
8947:FF 20 06 E2 20 57 E2 4C C1
894F:BD FF A9 00 8D 01 9F 20 46
8957:58 8A A9 A0 8D 00 9F 20 44
895F:72 89 A9 C8 8D 01 9F 20 9F
8967:58 8A A9 00 8D 00 9F 20 4A
896F:72 89 60 20 71 8D A0 00 2F
8977:8C 00 9E AD 01 9D 8D 01 1A
897F:9E 20 A0 8B 20 0A 8C 20 19
8987:56 8C AD 0A 9F 0D 09 9F 22
898F:F0 4B AD 08 9F 8D 16 9F 23
8997:20 30 8C 20 56 8C AD 0A A4
899F:9F 0D 09 9F F0 37 AD 08 A8
89A7:9F CD 16 9F F0 2F 20 6F AE
89AF:8B AD 00 9E 0A 6D 00 9E 82
89B7:0A AA AD 02 9F 9D 05 9E 6C
89BF:AD 03 9F 9D 06 9E AD 04 42
89C7:9F 9D 07 9E A9 00 9D 02 67
89CF:9E 9D 04 9E AD 00 9F 9D 4E
89D7:03 9E EE 00 9E AD 00 9F 3D
89DF:D0 08 B9 08 9D D0 46 4C 1E
89E7:FC 89 B9 08 9D D0 0E B9 99
89EF:0A 9D D0 39 AD 00 9F 38 02
89F7:F9 09 9D 90 30 AD 00 9E DD
89FF:0A 6D 00 9E 0A AA B9 0B D6
8A07:9D 9D 05 9E B9 0C 9D 9D B3
8A0F:06 9E B9 0D 9D 9D 07 9E E6
8A17:B9 08 9D 9D 02 9E B9 09 9F
8A1F:9D 9D 03 9E B9 0A 9D 9D 83
8A27:04 9E EE 00 9E AD 00 9D 0D
8A2F:0A 6D 00 9D 0A 38 E9 06 89
8A37:8D 16 9F 98 38 ED 16 9F 5B
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9737:B4 99 00 B5 99 00 B6 99 56
973F:00 B7 99 00 B8 99 00 B9 75
9747:99 00 BA 99 00 BB 99 00 56
974F:BC 99 00 BD 99 00 BE 99 03
9757:00 BF 88 D0 9D 60 A9 00 56
975F:A0 00 99 00 E0 99 00 E1 61
9767:99 00 E2 99 00 E3 99 00 1C
976F:E4 99 00 E5 99 00 E6 99 0A
9777:00 E7 99 00 E8 99 00 E9 6B
977F:99 00 EA 99 00 EB 99 00 55
9787:EC 99 00 ED 99 00 EE 99 B6
978F:00 EF 99 00 F0 99 00 F1 CD
9797:99 00 F2 99 00 F3 99 00 8E
979F:F4 99 00 F5 99 00 F6 99 63
97A7:00 F7 99 00 F8 99 00 F9 30
97AF:99 00 FA 99 00 FB 99 00 C7
97B7:FC 99 00 FD 99 00 FE 99 10
97BF:00 FF 88 D0 9D 60 A9 00 CE
97C7:85 FE 8D DB 9F AD FE 9F 3A
97CF:29 F8 85 FD 0A 26 FE 0A 53
97D7:26 FE 18 65 FD 90 02 E6 50
97DF:FE 0A 26 FE 0A 26 FE 0A B6
97E7:26 FE 85 FD AD FE 9F 29 4C
97EF:07 18 65 FD 85 FD 90 02 7C
97F7:E6 FE AD FF 9F 29 FC 0A B5
97FF:2E DB 9F 18 65 FD 85 FD DE
9807:8D EC 9F A5 FE 6D DB 9F 8D
980F:6D ED 9F 85 FE 8D EB 9F 64
9817:AD FF 9F 29 03 8D EA 9F 69
981F:60 05 40 00 00 FF FF 00 C9
```

Program 2: Animation Demo

```
JC 90 POKE51,255:POKE52,63:POK
      E55,255:POKE56,63
SE 100 INPUT"{CLR}{4 DOWN}DO Y
      OU WANT TO SAVE (Y/N)";
      NS$:IFNS$="N"THEN140
CH 110 IFNS$<>"Y"THEN100
XX 120 INPUT"DISK OR TAPE (D/T
      )";DV$
EX 130 IF(DV$<>"D")AND(DV$<>"T
      ")THEN120
XQ 140 CLEAR:SETCOLOR 1,6,0,14
      ,1:SC=9:RECORD:FORS=1TO
      70:AN=AN+10:C=C+1:SC=SC
      *.94
JE 150 TH=AN*↑/180
KA 160 A(1)=-10:B(1)=10:A(2)=1
      0:B(2)=10:A(3)=10:B(3)=
      -10:A(4)=-10:B(4)=-10
DA 170 NU=4:GOSUB1000:NEXT
KF 180 IFDV$="D"THEN:DPUT"SQUA
      RES"
MB 190 IFDV$="T"THEN:LOWRES:CP
      UT"SQUARES"
XM 200 PLAY:PLAY:CLEAR
CJ 210 SETCOLOR 1,6,0,7,1:SC=2
      :RECORD:C=0:AN=0:FORS=0
      TO70:C=C+1:SC=SC*.94
HJ 220 TH=AN*↑/180
JS 230 A(1)=-60:B(1)=40:A(2)=6
      0:B(2)=40:A(3)=0:B(3)=-
      75:NU=3:GOSUB1000
HA 240 A(1)=0:B(1)=75:A(2)=60:
      B(2)=-40:A(3)=-60:B(3)=
      -40:GOSUB1000:AN=AN+5:N
      EXT
PD 250 IFDV$="D"THEN:DPUT"STAR
      S"
HE 260 IFDV$="T"THEN:LOWRES:CP
      UT"STARS"
DQ 270 PLAY:PLAY:CLEAR
DK 280 SC=2:C=0:TH=0:SETCOLOR
      {SPACE}1,3,5,7,9:RECORD
      :FORS=0TO70:C=C+1:SC=SC
      *.94
AM 290 A(1)=-60:B(1)=40:A(2)=6
      0:B(2)=40:A(3)=0:B(3)=-
      75:NU=3:GOSUB1000
JA 300 A(1)=0:B(1)=75:A(2)=60:
      B(2)=-40:A(3)=-60:B(3)=
      -40:NU=3:GOSUB1000:NEXT
PD 310 IFDV$="D"THEN:DPUT"MORE
       STARS"
GG 320 IFDV$="T"THEN:LOWRES:CP
      UT"MORE STARS"
KB 330 PLAY:PLAY:CLEAR
KQ 340 SC=5:C=0:AN=0:SETCOLOR
      {SPACE}1,0,7,14,1:RECOR
      D:FORS=0TO1040:SC=SC+.1
      :C=C+1
GX 350 IFC=4THENC=1
HA 360 TH=AN*↑/180:A(1)=0:B(1)
      =0:A(2)=0:B(2)=1:NU=2:G
      OSUB1000:AN=AN+5:NEXT
AS 370 IFDV$="D"THEN:DPUT"RAYS
      "
GF 380 IFDV$="T"THEN:LOWRES:CP
      UT"RAYS"
DH 390 PLAY:CLEAR:PLAY:CLEAR
RC 400 OF=135:SC=700:GAP=500:D
      G=↑/180:SETCOLOR 1,6,0,
      7,1:RECORD
AP 410 FORAN=0TO180STEP5:TH=AN
      *DG:FORBE=0TO360STEP5:G
      M=BE*DG:DL=(BE+OF)*DG
HB 420 A(1)=-50:B(1)=40*SIN(GM
      ):C(1)=40*COS(GM)
DB 430 A(2)=50:B(2)=40*SIN(DL)
      :C(2)=40*COS(DL)
BB 440 FORN=1TO2:GOSUB4000:GOS
      UB5000:NEXT:C=3:GOSUB10
      20:NEXTBE:SWITCH:NEXTAN
AM 450 IFDV$="D"THEN:DPUT"WIRE
      S"
ES 460 IFDV$="T"THEN:LOWRES:CP
      UT"WIRES"
MC 470 PLAY:CLEAR:LOWRES:PRINT
      "{CLR}PLEASE WAIT..."
GM 480 DIM SN(360),CS(360):DG=
      ↑/180:FORX=0TO360STEP2:
      TH=X*DG:SN(X)=SIN(TH)
JH 490 CS(X)=COS(TH):NEXT:OF=1
      35:SC=350:GA=25:GM=30*D
      G:SETCOLOR 1,0,2,7,5:RE
      CORD
BP 500 FORAN=0TO342STEP2:TH=AN
      *DG:RESTORE:FORFA=1TO6:
      READC
CG 510 FORVE=1TO4:READA(VE),B(
      VE),C(VE):NEXTVE
JP 520 FORN=1TO4:GOSUB6000:GOS
      UB7000
GE 530 A(N)=A(N)+4-AN/50:B(N)=
      B(N)+4-AN/50:C(N)=C(N)-
      AN/20:GOSUB5000:NEXTN
MA 540 GOSUB1040:NEXTFA:SWITCH
      :NEXTAN
AH 550 IFDV$="D"THEN:DPUT"CUBE
      "
DA 560 IFDV$="T"THEN:LOWRES:CP
      UT"CUBE"
XB 570 PLAY:PLAY:LOWRES:END
ES 1000 FORN=1TONU:GOSUB2000:G
      OSUB3000:NEXT
CP 1010 ON NU-1 GOSUB 1020,103
      0,1040:RETURN
      0,1040:RETURN
MF 1020 FILL 2,C,A(1),B(1),A(2
      ),B(2):RETURN
XQ 1030 FILL 3,C,A(1),B(1),A(2
      ),B(2),A(3),B(3):RETUR
      N
CM 1040 FILL 4,C,A(1),B(1),A(2
      ),B(2),A(3),B(3),A(4),
      B(4):RETURN
SM 2000 Q=A(N)*COS(TH)+B(N)*SI
      N(TH)
AF 2010 B(N)=-A(N)*SIN(TH)+B(N
      )*COS(TH)
AE 2020 A(N)=Q:RETURN
BP 3000 A(N)=80+SC*A(N):B(N)=1
      00-1.4*SC*B(N):RETURN
QD 4000 Q=A(N)*COS(TH)+C(N)*SI
      N(TH)
KB 4010 C(N)=-A(N)*SIN(TH)+C(N
      )*COS(TH)
SH 4020 A(N)=Q:RETURN
KS 5000 K=GA+C(N):A(N)=80+SC*A
      (N)/K:B(N)=100-1.4*SC*
      B(N)/K:RETURN
JC 6000 Q=B(N)*CS(30)+C(N)*SN(
      30)
KH 6010 C(N)=-B(N)*SN(30)+C(N)
      *CS(30)
KF 6020 B(N)=Q:RETURN
XQ 7000 Q=A(N)*CS(AN)+C(N)*SN(
      AN)
SD 7010 C(N)=-A(N)*SN(AN)+C(N)
      *CS(AN)
MP 7020 A(N)=Q:RETURN
JF 8000 DATA 1,-1,+1,-1,+1,+1,
      -1,+1,-1,-1,-1,-1,-1
HG 8010 DATA 2,+1,+1,-1,+1,+1,
      +1,+1,-1,+1,+1,-1,-1
DH 8020 DATA 1,+1,+1,+1,-1,+1,
      +1,-1,-1,+1,+1,-1,+1
AE 8030 DATA 2,-1,+1,+1,-1,+1,
      -1,-1,-1,-1,-1,-1,+1
PD 8040 DATA 3,-1,+1,+1,+1,+1,
      +1,+1,+1,-1,-1,+1,-1
BB 8050 DATA 3,+1,-1,-1,+1,-1,
      +1,-1,-1,+1,-1,-1,-1
```

Program 3: Animation Player

```
KK 130 POKE51,255:POKE52,63:PO
      KE55,255:POKE56,63
CC 140 IFA=0THENA=1:LOAD"FILL-
      64",8,1
JX 150 SYS 33846:CLEAR
SC 160 DGET"SQUARES":PLAY
MX 170 DGET"STARS":PLAY
BG 180 DGET"MORE STARS":PLAY
FE 190 DGET"RAYS":PLAY
AJ 200 DGET"WIRES":PLAY
JJ 210 DGET"CUBE":PLAY:PLAY:PL
      AY
HX 220 SETCOLOR 14,6,0,7,14
BG 230 LOWRES:END
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Power BASIC: 128 Instant Keywords

(Article on page 82.)

```
AE 100 PRINT"{CLR}":S=DEC("130
      0"):BANK15:FORD=STOS+17
      6:READ A$:POKE D,DEC(A$
      ):NEXT
HB 110 M=S+22:V%=M/256:V=M-256
      *V%:POKE S+12,V%:POKE S
      +14,V:M=D-52:V%=M/256:V
      =M-256*V%
JG 120 POKE S+65,V%:POKE S+64,
      V: SYS(S):PRINT"
      {2 DOWN}{RVS}{WHT}INSTA
      NT KEYWORDS ACTIVATED
RK 130 PRINT"{DOWN}{RVS}TO DE/
      ACTIVATE SYS"S:NEW
JG 140 DATA A9,C8,CD,37,03,F0,
      04,A2,05,D0,04,A9,13,A2
      ,16,8D,37,03,8E,36
KE 150 DATA 03,60,EA,48,A6,F4,
      F0,04,68,4C,05,C8,A4,D4
      ,AD,3E,03,85,24,AD
AR 160 DATA 3F,03,85,25,B1,24,
      EA,38,E9,41
QA 170 DATA C9,1A,B0,E6,A2,02,
      E4,D3,D0,02,69,19,A8,B9
      ,7D,13,C9,27,B0,09
EE 180 DATA 69,7E,AA,A0,09,A9,
      46,D0,05,AA,A0,17,A9,44
      ,84,24,85,25,A0,00
MK 190 DATA CA,10,0F,B1,24,48,
      E6,24,D0,02,E6,25,68,10
      ,F4,30,EF,C8,B1,24
BH 200 DATA 30,05,20,0C,56,D0,
      F6,29,7F,20,0C,56,68,60
      ,EA,0B,18,C7,0D,D5
KA 210 DATA 81,89,D2,85,CF,E5,
      EC,CA,82,A3,99,E3,8E,07
      ,A7,FB,87,FD,97,DE
QD 220 DATA C8,C4,19,E7,0F,0A,
      03,8D,D1,D4,04,E0,E6,06
      ,17,A6,DF,E4,8C,DA
KQ 230 DATA 05,FC,83,1A,C2,E2,
      C9
```

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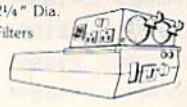

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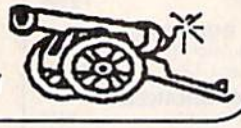

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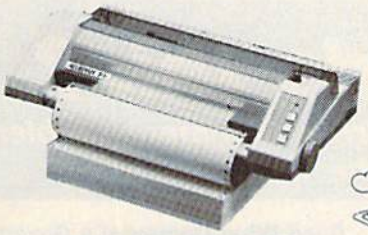

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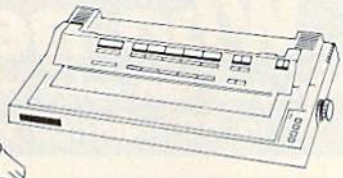

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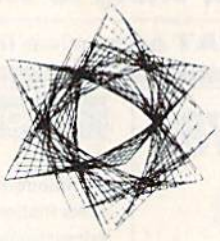

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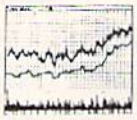

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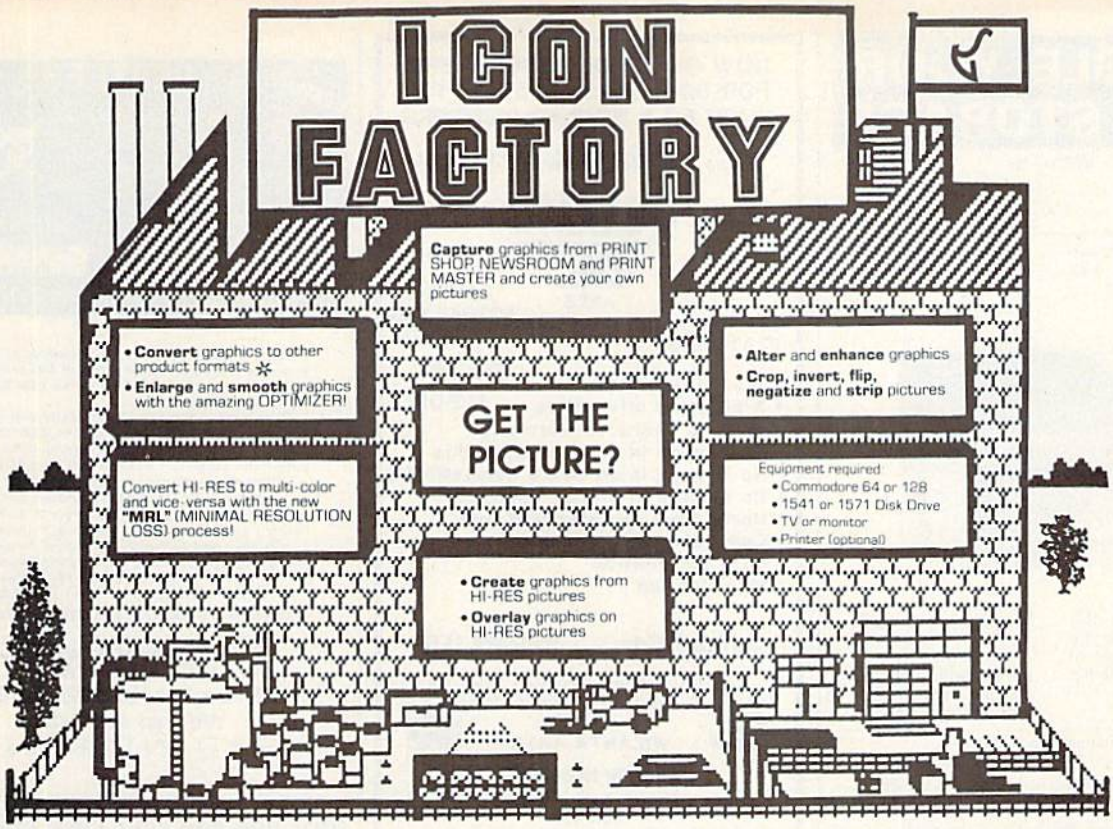
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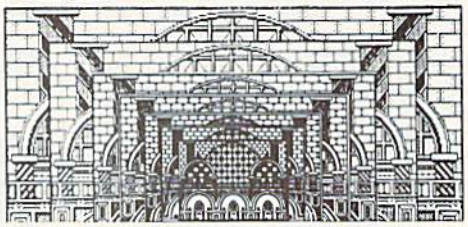

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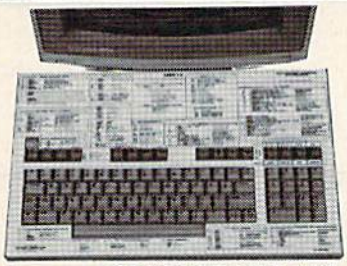

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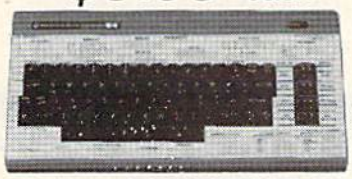

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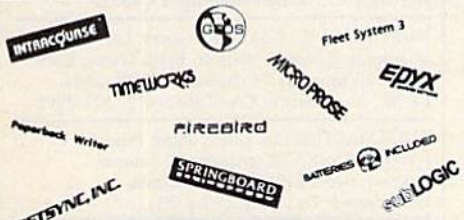

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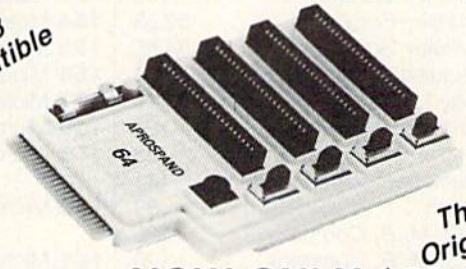

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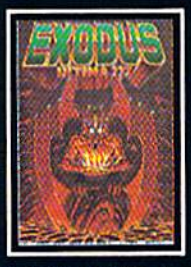

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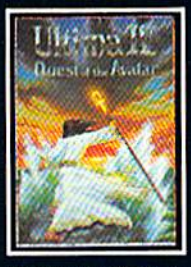

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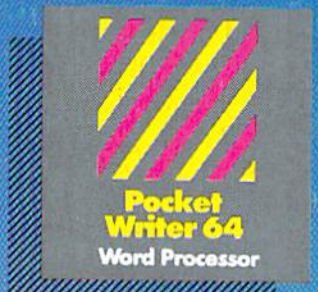

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